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A Weekly Journal Devoted to Industrial and Engineering Chemistry

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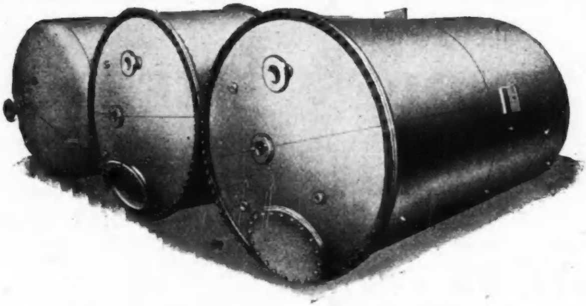

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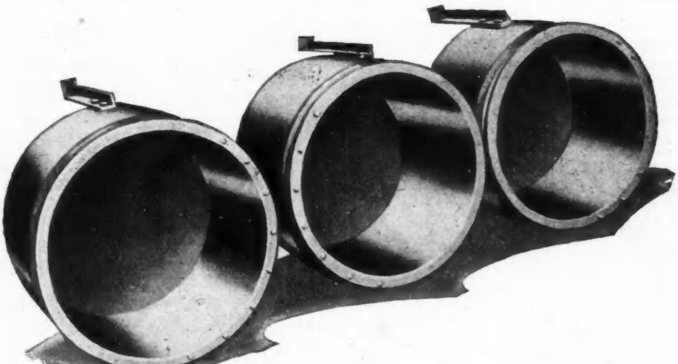

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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Chemist and the Civil Engineer

IT is, we believe, the Institution of Civil Engineers that in its Charter defines the purpose of engineering as the control and subjugation of the great forces of nature to the purposes of man, or words to that effect. The fact that there is a section of the Society of Chemical Industry which deals with road and building materials indicates the inter-relationship of chemistry and civil engineering and shows, moreover, that for all the grandiloquent charter phraseology of the Institution of Civil Engineers, engineering is becoming more dependent on chemistry. Chemistry, of course, is equally dependent on engineering, as it is only by the skill of the engineer that many chemical processes are made possible on the industrial scale. The essential difference is that whereas the chemist freely admits his indebtedness to the engineer and is prepared to work closely with the engineer, the engineer does not admit his indebtedness to the chemist and tends to regard the chemist as an inferior class of being who is useful for providing certain information, but whose usefulness is strictly limited to subsidiary activities. It was an interesting experience to attend a meeting of the Roads and Building Material Group of the Society of Chemical Industry last month, and to hear a general discussion on "The Rôle of Chemistry and Physics in the Road and Building Industries."

The title of the debate was not very well chosen. Five short papers were given, each of which dealt with a specific application of chemistry or physics to these industries, but the discussion was in no sense so general as the title suggests that it might have been. We heard, for example, how coal tar had been developed and improved since the original Road Tar Specification of 1911, and it was pointed out by Colonel Potter that so far as could be seen at the moment the greatest advances were likely to be made by the methods of solvent analysis in which road tar is divided by light aromatic solvents such as benzene and toluene, by heavier solvents such as pyridine, and by light petroleum, into three or four fractions which for the moment are termed C_1, C_2, C_3, etc. This work has been going on for some years and a good advance has been made. The method used is not dissimilar to that used for the separation of coal into several groups of compounds each of which has a particular rôle to play in the production of coke on carbonisation. It appears that the

On Other Pages

fractions obtained from tar by solvent analysis have each a particular rôle to play in the setting of the tar. It appears also that the use of lime in connection with both tar and bitumen so far modifies the properties of the materials that they are improved for road purposes.

An interesting problem that has been solved in connection with bitumen is that of making a sound road surface with wet sand. Hitherto it has been necessary to dry sand and stone, but it has now been found possible to displace the water from the surface and to replace it by bitumen without the need for drying by heat. The study of soil mechanics has proved exceedingly useful in connection with the preparation of surfaces. Mr. Jarmay gave a very interesting account of this part of the subject, though there is evidently a great deal which cannot be published just yet.

A study in pure physics was the discussion by Dr. Lea on the plasticity of materials, particularly of lime putty, mortar, and cement, in which their workability was defined in terms of plasticity and coherence. The essential difficulty is that a workman is able to give a subjective opinion on the workability of any particular material, but that scientifically it is necessary to replace this subjective opinion by concepts which admit of objective measurement. It appears that workability involves plasticity and cohesion, including the retention of water, and that of many different factors involved one may in any given set of circumstances be more important than others.

Mr. Rigden discussed the methods involved in size analysis for very small particles. He believes that the time is rapidly approaching when it will be no longer sufficient to specify that a mortar or cement shall contain a suitable proportion of material under 200 mesh, but that this very fine material must be still further subdivided. The methods used will probably be those of elutriation, sedimentation, or estimation of surface area by absorption of a gas or liquid. Finally, a very interesting account was given of a method for determining the molecular weight of tars, pitches, bitumen, "free carbon," and other materials.

It is evident from this account of the advance in the chemistry and physics of road and building materials that chemists and physicists are making a most valuable contribution to the science of civil engineering. It was also evident from the sense of the meeting that engineers are not in general making adequate use of the services of chemists and physicists. The chairman maintained that the chemist and physicist were aiming at the prevention of waste and of making the full use of materials available. This, he said, demands accurate knowledge, but the amount of organised research in these industries is very small indeed. There is a little research in the road industry, principally, we suspect, carried out by those who provide the materials of construction, and apart from the work of the Building Research Station there is no organised research work in the building industry. The insufficient utilisation of the physicist and chemist was roundly declared to be due to lack of appreciation of their value in certain quarters. A bridge must be built between the scientific man and the practical man and the practical man must be made to realise that the chemist is the "cheapest form of labour on the market." The chemist and the physicist should invent and develop processes, should maintain quality, and should supervise the application of processes and the results; it was also daringly suggested that they should collect a fair share of the profits.

There must be close co-operation between the chemist and the engineering staff, but that co-operation demands not only a better realisation of the value of science from the civil engineer, but also a better approach to the engineer on the part of the chemist. The chemist is too prone to make his report unintelligible to any but those who speak the same language—or should we say "jargon?"—as himself. It seems evident that scientifically civil engineering as applied to roads and buildings is in a backward state, but it may not be quite so backward as some of the speakers implied. The bridge to which the chairman referred can only be built from within the industry and it will probably have to be built from the scientific side towards the engineering side by convincing the engineers of the value of science. The experience of other industries shows that when this has been done progress generally becomes very rapid.

NOTES AND COMMENTS

Education for Peace

VICE-PRESIDENT WALLACE hit the nail on the head this week when he recommended a form of corrective education as a likely cure for the disease of Nazism, Hitlerism, Prussianism—call it what you will. No country in the world, except Germany and Japan, has purposely directed the energies of its Youth to the glorification of the State and the ruthlessness of war; and, as Mr. Wallace says: "Prussian schoolmasters have been of greater importance to the German Army than Prussian captains, and Prussian text-books have had greater value than ammunition." If this war is to end in peace, and not in an uneasy interval of preparation for "World War III," the United Nations will have to cope immediately after the war with the education problem. Mr. Wallace was speaking primarily to Americans, and he justly lashed us for our "soft lazy forgetfulness" in the 'thirties; but his advocacy of a democratic Christian ethic for the future appeals to all nations irrespective of whether they are officially labelled "Christian" or not. The higher politics are not the province of industrial scientists; but the attitude of the United Nations towards education can be deeply affected by the precepts and practices of scientific men. Another special direction in which their influence can be brought to bear for good or ill is in the field of the full utilisation of natural resources. Mr. Wallace warns against "selfish pressure groups," which can be industrial as well as political. The nations must be assured that the special knowledge of men of science is not directed towards petty departmental ends and away from the service of Man.

Co-operation in Maintenance

LAST week we published a letter from the chairman of the British Chemical Plant Manufacturers' Association, asking for further co-operation between the makers and the users of chemical plant. In our leading article to-day it is recorded that in yet another branch of activity where industrial chemistry and engineering are both concerned, there is a feeling that a more positive attempt to get together would be of advantage to all concerned. In this issue, which is largely devoted to the proper maintenance of chemical plant, it seems apposite to stress the benefits to plant-users which must come from closer co-ordination with the engineers who are responsible for making the plant. According to their own showing, as reported in our leading article, chemists are beginning to feel that perhaps they have not employed the best methods in seeking to impress the engineers with their general usefulness. Probably, like most of their fellow-countrymen, they are naturally inarticulate, and expect everyone to take them at their face value, which they themselves know to be genuine. The facts of the case are, however, that most people are too busy (especially nowadays) to assess the value of persons outside their own immediate sphere, unless some means is employed of calling this value to their attention. Advertisement is one method, of course; but there is no harm in trying to see what can be done with a little official co-operation. We respectfully suggest to all makers and users of chemical plant that many plant troubles could be obviated if a closer contact between chemical manufacturers and chemical engineers could be contrived.

Metallurgical Research

CO-OPERATIVE research in the metal industry was advocated by Dr. Harold Moore in London last week, when he gave a paper at the annual meeting of the Institute of Metals. He suggested a national research association, saying that such an association was the obvious means for promoting extended co-operation, not by replacing the research associations of manufacturers, but by undertaking work on large problems common to the whole industry and by collating the research carried out in the laboratories of members. Such a suggestion, emanating as it does from one who for ten years has been director of the British Non-Ferrous Metals Research Association, is especially worthy of consideration. We should be interested to learn whether the metal industry will adopt this plan and co-ordinate all research findings, or whether it will be content, in the post-war reconstruction period, to continue its present methods with separate associations for various

branches, allowing the work to fall mainly on individual metallurgists.

The Future of Natural Rubber

THE plantation rubber industry has been warned by Mr. Eric Macfadyen, Vice-Chairman of the Rubber Plantations Investment Trust, against possible implications arising from the development of substitutes. He added, however, that the chemists had been at work in the natural rubber field also, and there appeared to be wide scope for the treatment of latex in the field or the estate factory with a view to giving the manufacturer what he required. His suggestion that the constitution in London, without delay, of the nucleus of the future administration of Malaya would be most helpful to all concerned with its reconstruction after its recovery, is an admirable one, but the recovery of the country itself is the first consideration. It is little use thinking of future administration until something is more apparent as to the state of the country for which the administration is required. The Japanese may leave Malaya in such a devastated state that it will take years for the plantations to be brought back into production; in the meantime synthetic rubber developments may well be so firmly established that reorganisation of the natural rubber industry will have to be newly considered in the light of experience then gained.

Resident Adult Education

AMONG the multifarious projects which are even now under consideration for adoption after the war, there is one which industrial chemists, and other technical men, will do well to keep an eye upon. We are referring to the proposed system of resident adult education, which is the subject of a sixpenny booklet just published by the Educational Settlements Association. There are several reasons why such a scheme is likely to come to fruition. Apart altogether from the merits of the case—and Sir Richard Livingstone has said "To cease education at 14 is as unnatural as to die at 14"—it must be remembered that adult education has been proceeding with vigour in the Services; the present Army course of instruction in fuel efficiency is only the most recent example of what we have in mind. Further stimulus is provided by the growing number of gifts to the National Trust of large country mansions which provide ideal accommodation for the educational courses suggested. Bearing these facts in mind, the point we wish to make here is that associations of scientific industrialists of all kinds should keep a watch on the progress of the scheme, and see that they are taken into consultation regarding the scientific and technological part of the syllabus when adult education does start on these lines.

Soil Chemists' Achievement

DURING 1942 soil samples examined in the laboratories of advisory chemists under the Ministry of Agriculture's provincial advisory service numbered 113,000, a quantity that does not include the thousands of rapid soil tests made in the field. Although soil analysis has never before been attempted on so large a scale, and there is an increasing demand for the service, many farmers are still sceptical of having samples taken, especially from freshly ploughed-up land. In fact, these soil tests not only give valuable information, but the analyses indicate how best to distribute the fertilisers, an important factor in wartime when many kinds of artificial fertilisers are in short supply and maximum crop yields are essential. On this question of fertilisers it is stated in some quarters that sulphate of ammonia is less plentiful now, but the limiting factor in the compound-fertiliser outlook is probably sulphuric acid.

Waste in Industry

"IF society is to benefit by its war experience, it cannot allow a situation to establish itself in which waste material of value is allowed to rot because of the owner's neglect or inertia," said Mr. G. S. Mason, vice-chairman of the Leeds and District Centre of the Institute of Industrial Administration, at Leeds last Saturday. He suggested that factory inspectors should be given more power to deal with flagrant waste of raw material. Policy seemed to fall into two main lines—the reduction of waste in the factories and workshops and the introduction of recovery plants for dealing with unavoidable waste. Evidence appears to support the contention that less than 50 per cent. of manufacturers had taken practical steps to deal fully with their waste products.

Petroleum in the Chemical Industry

II.—The Secondary Products

by J. E. WALKER

[*Continued from* THE CHEMICAL AGE, *March* 6, *p.* 266.]

IT is realised by none better than the author that the previous section of this article was but a sketchy outline of what is to-day an immense industry; but it is hoped that it has proved sufficient to indicate what basic raw materials are available for chemical synthesis from petroleum. In this section an attempt will be made to outline some of the possibilities offered, by carrying out such processes as polymerisation, oxidation, nitration, hydration, and hydrogenation, on the primary products.

As can be seen from Table I, these primary products are nineteen in number, as follows: Hydrogen, methane, ethane, propane, butane, *iso*butane, butadiene, diphenyl, ethylene, propylene, butylene, *iso*butylene, benzene, toluene, xylene, acetylene, paraffin waxes, diolefines, *cyclo*paraffins. For the purpose of this article, out of our list of nineteen primary products, four may be almost ignored. These are hydrogen, diphenyl, acetylene, and the *cyclo*-paraffin group. The first can be ignored because it falls into a completely different category from any other primary product, the second and third are ignored because of the small amount available at present, although improved processes may at any time change this state of affairs; and the fourth because it is rarely used for other purposes than cyclisation, which has already been dealt with in a previous section. A start will be made with the lowest of the paraffins.

Oxidation of Methane

The oxidation of methane yields a number of valuable products, the chief of which is undoubtedly methanol. The process is catalytic, and yields of up to 57 per cent. of the alcohol have been obtained. At the moment it is doubtful whether this process could compete economically with the usual process, *i.e.*, methanol from carbon monoxide and hydrogen, but improved technique should overcome this difficulty. Similarly, the oxidation of mixtures of methane and ethane, again with the aid of various catalysts, gives good yields of formaldehyde, but this also offers economic difficulties when compared with the present commercial method. However, a satisfactory process, economically, for the production of methanol will automatically solve the economic production of formaldehyde, and it is therefore possible to include these two important compounds as secondary products. In contrast, a method has recently been patented for the production of hydrogen peroxide from propane. It consists of partial combustion and rapid cooling of the products of this combustion, and good yields are claimed.

The oxidation of the higher paraffins in a pure state does not appear to have received a great deal of attention except in the laboratory, but the experimental oxidation of natural gas has led to the production of mixtures of alcohols, aldehydes; ketones, and acidic compounds. Further research on oxidation reactions and improved methods of separating the constituents of the resulting mixtures obtained should lead to many processes of interest to chemical manufacturers.

Nitration Compounds

Nitration of the lower paraffins has progressed considerably, and a number of valuable compounds are now prepared commercially. Nitration is carried out in the vapour phase, at temperatures around 400-450° C. The acid and selected hydrocarbon are intimately mixed by any suitable means, and injected into the nitrator, which is kept at the required temperature. At the temperatures mentioned, nitric acid is decomposed, the main product being nitrogen peroxide, which is the active nitrating agent. Ethane, propane, and butane have been nitrated commercially by this method, or others very similar, while methane and also pentane have been processed successfully on a semi-commercial scale. The manufacture of nitroethane has received the most attention, since it forms a very useful raw material for the manufacture of explosives. The nitration of natural gas has resulted in the production of some interesting mixtures of

nitroparaffins, and while increased knowledge will lead to more use being made of various pure nitroparaffins, the mixed nitro-compounds should repay research, if regarded in the mixed state as a chemical intermediate. Probably two of the most fruitful grounds for experimental work at the moment are the oxidation and nitration products of the lower hydrocarbons.

Turning next to the mono-olefines, a much wider scope is offered, owing to the greater reactivity of these hydrocarbons. While a great deal of work has been done, and a number of useful compounds prepared, it is somewhat surprising that more has not yet been achieved. However, considerable progress is probably hidden by the clouds of war, and in the interests of national security, little information on technical progress is available. At temperatures of approximately 550° C., without catalyst, ethylene may be successfully oxidised to ethylene oxide and formaldehyde. Very careful control of processing conditions has led to good yields of both products, and it should be especially noted that this offers another and probably a more economic method of obtaining formaldehyde from petroleum than does the oxidation of methane/ethane mixtures.

Production of Aldehydes

The controlled non-catalytic oxidation of propylene gives a mixed product consisting mainly of acetaldehyde, formaldehyde, and formic acid, and improved methods will certainly add these important secondary products to the list. Mixed products appear to be the general result of oxidising the mono-olefines, but that it is merely a question of finding the correct conditions, and probably suitable catalysts, to correct this feature, is shown by the result of a special oxidation process now being used on a commercial scale. Thus, by using either potassium permanganate, persulphuric acid, or potassium chlorate, with osmium tetroxide as a catalyst, it has been found possible to produce a number of glycols from the corresponding olefines. Ethylene glycol, a product of prime importance in war-time, is now manufactured by this process, and doubtless other glycols will be commercialised similarly. It appears that there are a number of processes operating on a commercial scale, for the production, by oxidation, of mixed aldehydes from mixed cracking gases, but to what extent this has led to the production of pure compounds is not known. In view of the great importance of the aldehydes in synthetic chemistry, further investigation here should prove well worth while. Probably of greatest interest to chemical manufacturers, however, is the hydration of mono-olefines, and the consequent production of various alcohols.

Alcohols by Hydration

While the bulk of the ethyl alcohol used to-day is still the result of fermentation processes, it is now possible to produce large quantities of ethanol from petroleum, by the hydration of ethylene. The gas is converted to the alcohol by steam in the presence of a suitable catalyst, such as pyridine, alumina, or the acid phosphates, and the process is being operated successfully on a commercial scale, thereby providing one of the most important secondary products. Using somewhat similar processes, commercial yields of *iso*propyl alcohol have been obtained from propylene, butyl alcohol indirectly from ethylene, and secondary butyl alcohol from butylene. At the moment, most of these alcohols are made by the sulphuric or phosphoric acid absorption process, but continuous vapour phase treatment, with a dilute acid catalyst, is becoming increasingly popular. For example, there are indications that the commercial production of *iso*propyl alcohol and *iso*propyl ether by the direct hydration of propylene is already being carried out. Processing is done under pressure with a dilute acid catalyst and by varying the conditions, good yields of either product can be obtained.

A somewhat similar process has also been patented for the production of di-*iso*propyl ether from olefine/paraffin mixtures, over a dilute sulphuric acid catalyst. Higher olefines appear to have received little attention, but there does not seem any particular reason why processes similar to those described should not lead to the production of higher alcohols. That the production of these alcohols offers enormous scope is shown by that fact that already they are being utilised for the preparation of solvents, fuels, esters, aldehydes, acetic acid and

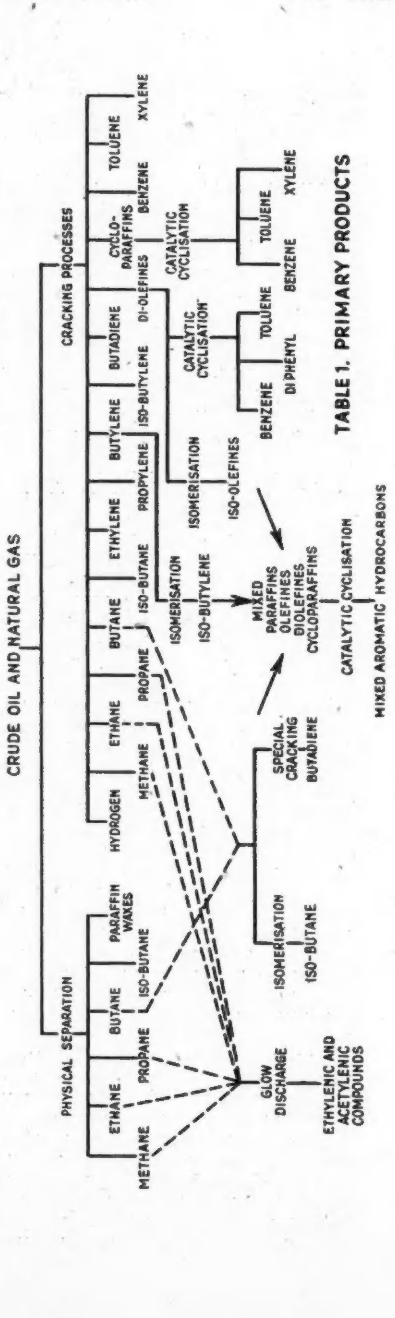


TABLE 1. PRIMARY PRODUCTS

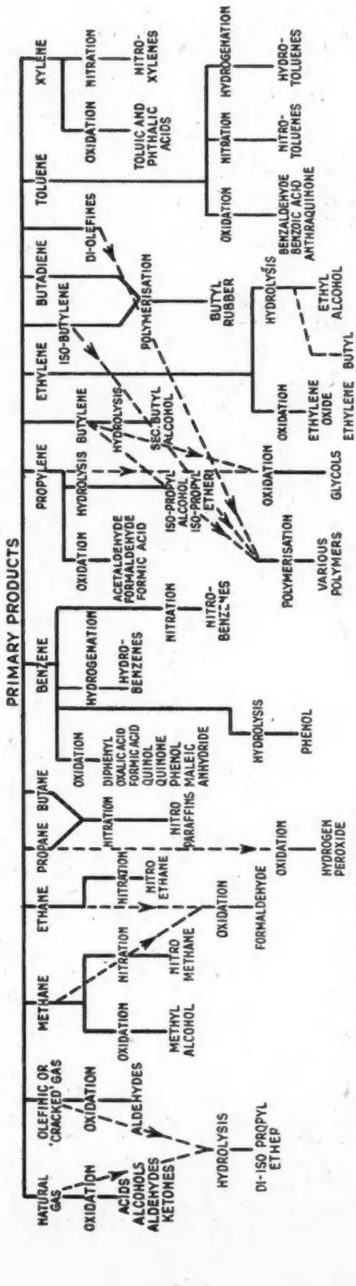


TABLE 2. SECONDARY PRODUCTS

anhydride, perfumes, cosmetics, and various medicinal products.

Acetylene behaves somewhat differently, and it has been found quite possible, by reacting it with water, in the presence of a mercuric salt as catalyst, to obtain satisfactory yields of acetaldehyde.

As with the oxidation processes, so with hydration it has been found comparatively easy to treat mixtures of olefines, and thereby obtain mixed alcohols, which are finding wide use as general solvents, particularly in the preparation of cellulose lacquers. But quite obviously, the greatest possibilities are centred around the preparation of pure compounds. However, enough has been said to indicate that the olefines from cracking gas offer an almost limitless field for chemical synthesis.

Oxidation of Benzene

The next group of primary products to be considered is that composed of the aromatic hydrocarbons, benzene, toluene, and the xylenes. Although benzene is such a stable compound it can be oxidised, and, under carefully controlled catalytic treatment, a number of interesting compounds can be obtained. The first result of the high-temperature treatment of benzene is the combination of two molecules of benzene to form one molecule of diphenyl. Although the process is somewhat difficult, since diphenyl is even more resistant to oxidation than benzene, very good yields of the former have been obtained, and its commercial success almost assured. The continued vapour-phase oxidation under varying conditions has led to the production of oxalic acid, formic acid, quinol, and quinone, but as yet the processes have not advanced beyond the experimental stage.

The main commercial product at the moment from benzene by oxidation is probably maleic anhydride. The process utilised is catalytic, and many materials have been patented as suitable catalysts for this reaction. The most successful would appear to be vanadium pentoxide, used at a temperature of about 450° C., when yields of 40/50 per cent. of the anhydride are obtained, based on the weight of benzene used. Another oxidation process which has reached the experimental stage successfully, is that for the production of phenol from benzene Details are lacking, but it is to be hoped that a successful commercial process will be developed, in view of the extreme usefulness of phenol as an intermediate, especially in the production of explosives, not necessarily for warlike uses.

Toluene and Xylene Products

While the oxidation of toluene can be carried out quite successfully, little commercial progress appears to have been made; doubtless owing to the fact that the three main oxidation products, namely benzaldehyde, benzoic acid, and anthraquinone, are at the moment available from other and cheaper sources. However, here we are more concerned with possibilities than with economies, since with improved methods these compounds obtained from petroleum will undoubtedly compete economically with the same compounds produced from other basic raw materials.

The main products of the oxidation of toluene are benzaldehyle and benzoic acid, and their proportionate yields are regulated by processing conditions. Thus, short contacting times, mild catalytic conditions, and high temperatures lead to greater production of the aldehyde, while lower temperatures, more powerful catalytic conditions, and longer contacting times favour the production of the acid. For example, in the production of benzoic acid, temperatures of 280/300° C. over a vanadium oxide catalyst have proved very successful, while yields of over 50 per cent. of benzaldehyde have been obtained, using the same catalyst, but at temperatures of some 400/450° C. At the upper temperature limit, up to 5 per cent. yield of anthraquinone has been obtained. Another process of a different type, is the electrolytic oxidation of toluene to benzaldehyde, using manganese dioxide and sulphuric acid. This method might prove interesting, since it could in all probability be operated comparatively cheaply.

Oxidation of the xylenes, usually carried out in two stages, leads to the production of carboxylic acids. Dilute nitric acid or chromic acid is often used to carry out the oxidation, and when the first stage of the process has been reached, the product is a mixture of the monocarboxylic acids, *ortho-*, *meta-*, and *para*-toluic. Continuing to the second stage, these are converted to the dicarb-

oxylic derivatives, *ortho-*, *meta-*, and *para*-phthalic acids respectively, but little practical use seems to have been made of this process.

The nitration of aromatics from petroleum is already a large and important industry, and is growing rapidly. The nitration of benzene and toluene is too well known to require describing here, but since these aromatics, as well as phenol, are available from oil, this alone would provide a huge source of raw material for chemical synthesis, besides supplying huge quantities of explosives. On mild nitration of benzene, the first product is mononitrobenzene, used to a certain extent in explosives. But it is as an intermediate that its greatest promise lies, since it is possible to manufacture aniline from this nitrobenzene, and open up the whole aniline chemical monopoly to competition. Continuing the nitration process, di- and trinitrobenzenes are obtained, both useful as explosives and intermediates, but not to the same extent as the nitrotoluenes.

Nitrotoluenes

All three nitrotoluenes are easily prepared, and all are manufactured on a large scale for use as explosives, of which trinitrotoluene is by far the most powerful. Although the potentialities of trinitrotoluene were realised about 1880, it is still, to-day, probably the most important material used in the filling of shells, bombs, and mines. Modifications have been introduced, and other materials added to improve its explosive power, but it remains the basis of most modern high explosives, hence the present importance of toluene from petroleum. Another very important explosive is picric acid, or lyddite, made by nitrating phenol. Thus a convenient method for the production of phenol from oil will also provide another important secondary product. Incidentally, a process was brought out during the last war for the production of picric acid from chlorinated benzene, but whether this process has been developed is not known. The three xylenes may be nitrated in the same way as benzene and toluene, but up to the present there appears to be little demand for the products.

Hydrolysis of the aromatics does not seem to have been productive of any startling results, except to offer a new line of approach to the preparation of phenol. For example, benzene in the vapour phase, and steam, are passed through a quartz tube held at a temperature of 600/700° C., the yield of phenol being promising. Although little work appears to have been done along this line up to the present, there does not appear to be any reason why the naphthols should not be synthesised in a similar way. Hydrogenation of benzene and toluene over a nickel catalyst leads to the successive production of a number of hydro-aromatics, but there appears to be little evidence of any commercial use being made of the process.

The Diolefines

There now remain of the Primary Products but two classes for consideration, *i.e.*, the diolefines, and the *cyclo*paraffins. The latter class is usually catalytically recycled for the production of aromatics, and will not be further considered here. The diolefines, however, provide one of the most interesting, and certainly one of the most complex raw materials obtainable from petroleum.

Taken as an example of the class, butadiene at the moment stands supreme, as being the corner-stone of the synthetic rubber industry. As early as 1860, investigations into the possibilities of synthetic rubber were being carried out, and by 1884 the properties of methyl butadiene were appreciated. By 1910 it had been found possible to polymerise butadiene to a rubber-like composition, and, to-day, with the increasing production of butadiene from oil, it would appear that a great new industry will be built up, using petroleum raw materials. At first, supplies of butadiene were obtained from ethyl alcohol, and naturally this caused the price of synthetic rubber to be high when compared with the natural rubber. With cheap and plentiful sources of butadiene from petroleum, this main difficulty is rapidly being overcome.

To-day, two main types of synthetic rubber are being manufactured, namely Buna rubber and butyl rubber. The former is made from butadiene, polymerised with either styrene or acrylonitrile, yielding two different grades of finished rubber, while the latter type is made from olefinic gases, mainly butylene, by polymerising them with butadiene. Thus while butadiene can be obtained from other sources, it seems

fairly clear that petroleum will eventually provide the bulk of the world's synthetic rubber in the future. Neoprene, a rubber-like polymer of acetylene, could also be produced from petroleum, but with the greater availability of butylene and butadiene, it would probably not prove economic, and "butyl" rubber will probably take first place.

Synthetic Rubbers

From the point of view of the petroleum industry "butyl" is the most interesting of the synthetic rubbers, since it is a 100 per cent. petroleum product. A polymer of butylene, it has a molecular weight of about 60,000. Containing very small quantities of diolefines, it is essentially of paraffin structure, and thus has little unsaturation when finished. Hence its stability is high, the unsaturation being only just sufficient to allow for sulphur curing. The finished product can be processed much like ordinary rubber, is very resistant to chemical attack, and has high tensile strength, although not quite so resistant to solvent action as some other types.

Many different grades of these rubbers are now being produced, and while it is doubtful whether any one of them is the equal of natural rubber in every respect, it is equally true that each in its respective field is probably superior. Thus a synthetic rubber can be made which is more resistant to wear than natural rubber; another has greater tensile strength; another has greater resistance to solvents. Yet another is being specially prepared for the manufacture of chewing gums, but whether its virtue is in its flavour or in its wearing qualities is not yet known on this side of the Atlantic! The field is fairly well covered, and the future of the synthetic rubber industry assured by the supply of raw materials from petroleum.

In addition to synthetic rubber, many other polymerisation products are available from petroleum, but since in the main they are mixtures of compounds about which, in many cases, there is little definite knowledge, they ought properly to be omitted from this article. However, their great importance and great promise for research and future development makes necessary a brief reference. The simplest processes are those using mixtures of mono-olefines and *iso*paraffins, with sulphuric or phosphoric acids as polymerising agent. There are many such processes patented, and a tremendous amount of high-grade aviation spirit is now made in this manner. Similarly, synthetic lubricating oils can be made, and, for special uses, prove better than those obtained directly from petroleum. Polymers of ethylene and *iso*-butylenes are rapidly coming into prominence, and can be used as greases and lubricating compounds, insulating materials, synthetic wood and safety glass, to mention only a few. In addition, by oxidising and/or chlorinating these olefinic polymers, still another range of materials can be provided. Commercial production has already been achieved, by such processes, of materials suitable for thermoplastic moulding, the preparation of varnishes, and wax-blending agents to improve toughness and insulation properties. Thus, with a plentiful supply of cracking gas, a whole host of useful products can be obtained, varying according to the polymerisation process adopted. While in a somewhat different category to the other compounds previously mentioned, their potentialities must make them extremely interesting.

The Promise of the Future

Concluding this second section on the production of secondary products, it is feared that the general effect has been rather sketchy, and in danger many times of becoming more like a catalogue than a literary effort. The main difficulty has been in condensing into a short space, as much information as possible, outlining the potentialities of petroleum as a raw material. In spite of many omissions and abbreviations, enough has probably been said to show what has been achieved, and what the future promises. Justice has certainly not been done to many successful and important processes, but more detailed information on these can be obtained from appropriate sources.

Not including the polymers, or mixed products such as aldehydes and ketones, we thus have, as secondary products, some thirty to forty pure chemical compounds (Table II) the bulk of which form very valuable intermediates for further synthesis. In the concluding section, these possibilities will be considered as completely as space permits.

(*To be continued.*)

From a Works Maintenance Notebook

THE routine tasks—often monotonous, sometimes disagreeable—which have to be done to keep plant from "going sick," can be much lightened if more attention is given to "features" in the design of a new piece of equipment, and to just where that equipment can be installed in relation to the rest of the plant to make inspection easy and yet no less serve its purpose. Plant makers do not carry new features of design into production merely for the fun of issuing literature, paying patent fees, and being put to fresh expense of patterns for casting and jigs for machining; plant purchase on the part of the user is not too frequent to be "easy money" to the maker. Therefore, when new plant is contemplated, consider well what the plant makers have to offer, and with an eye on maintenance costs consider still further those particular features which are affected. Co-operate with the maker in the matter of refinements to the design which your own experience indicates; welcome the advice which the maker is able to offer from his collected experience in serving others, and with knowledge of engineering difficulties which arise in the task of making the plant. Finally, take an equal amount of care as to where the plant or equipment shall be placed to function as part of your works, remembering that the task of inspection for maintenance is ever present, and that the easier it is to inspect so will it be the easier to do the maintenance work or repairs which inspection shows to be necessary.

* * *

Equipment which has been installed in a position difficult to reach, will greatly delay the execution of "emergency" repairs; fitters may seem quite content to wriggle through a maze of pipework and coil-up arms, legs and body to do a particular job, but it is not pleasing nor good for the temper of the man, and let it be well remembered that new pieces of equipment may not have the same degree of flexibility as that of the fitter's body, with the result that considerable dismantling may be necessary before the change is effected, and labour costs as well as time lost in production may prove higher than ever anticipated.

* * *

What may be called "emergency repaire" need never arise where plant is kept in a healthy condition by conscientious inspection and timely maintenance work, save in exceptional circumstances. Maintenance men, however, need to be selected carefully; they must work steadily through a pre-arranged programme, under the direct supervision of plant manager or engineer. Maintenance is no idle task; it demands experience reaching out in a hundred directions, and to expect a poorly-trained man to accomplish all that is required only leads to unpleasant experience in running the plant from month to month. Plant "wears," and some plant "tires" under the stress of a laborious task, and in order to detect the need for attention and know what has to be done and how it must be done, common experience should have assistance from plant maintenance records.

* * *

Every piece of plant for any unit operation —now many and varied in their precise purpose—and every individual piece of equipment or component part of the plant, should have its maintenance history recorded and filed. From the office point of view this recording may seem unduly laborious, and indeed, for a large works the task may well occupy the attention of more than one person, but experience shows that time taken up by this work is not time wasted. The records offer experience which it is impossible to obtain elsewhere; they stand on the same level of importance as records from which production costs are checked, and no chemical works can be operated on a sound economic basis without a knowledge of production costs. Equipment goes on file when it is installed, ready for service; the initial particulars to be entered concern make and pattern, date of purchase, date of installation, and initial cost. Thereafter are entered a note of all inspections, with date, and what may have been done in the matter of general maintenance—for example, lubrication, or renewal of packing material—or repairs of more concrete nature—for example, the re-bushing of a bearing.

* * *

The buildings which house and offer shelter to chemical plant have need of maintenance just as much as the plant itself; sad it is to reflect that they are often forgotten, but this state of affairs is quite common in the small works. Metal roofs, and also the supporting steelwork—buildings and plant staging—suffer the effects of corrosion in a fume-laden atmosphere; brickwork needs attention, if there are settlement cracks; woodwork, unless it is well painted with the right type of paint, deteriorates from undue moisture in the air, from dripping or seepage of acid, and from the heat of steam pipes. Undetected dripping of acid will soon weaken supporting steelwork or a brick foundation; the impending disaster, as in the case of a large stoneware tower, can be serious. And, just as the wick of an oil lamp needs occasional trimming, and the glass chimney has to be cleaned at regular intervals (remembering that paraffin oil is still used in large amount as illuminant when there is neither electricity nor gas), so too the burner or grate

of a furnace, and its flue, is in need of attention if full advantage is to be made of the heat value of the fuel.

* * *

The rate at which plant and equipment depreciates varies with type and usage; authorities offer us a set of pretty figures with which we may work out an item to enter in the company balance sheet, but a study of plant maintenance records (at our own works) can show just how our plant depreciates, in what component parts or pieces of equipment, how speedily, and at what replacement cost.

* * *

Low maintenance costs, in all aspects of chemical engineering, follow the selection of the right material from which the plant parts are made. Constructional materials are no longer just iron, a few non-ferrous metals, brick and wood; the choice is almost bewildering with alloys in profusion, and an almost equal range of non-metallic materials of differing grade. Therefore study the task to be done in the light of what service is offered by selected materials; discuss this matter with the plant maker, you knowing something of the way in which plant deteriorates when operating your processes, and the plant maker offering his wealth of experience as to what can and what cannot be done in fabrication for a satisfactory job. Low maintenance costs depend on the use of proper materials, but do not run off with the idea that maintenance can be abolished or made unnecessary; no material yet discovered is so perfect from the chemical engineering outlook, no workmanship in fabrication of the plant does not offer a minute defect which acid or alkali, in time, will detect.

Research in Metals

National Metallurgical Association Advocated

IN the matter of reconstruction, the vital question, is not "Can we afford the cost?" but "Can we afford to neglect our resources?" said Dr. Harold Moore, C.B.E., at the annual meeting of the Institute of Metals in London last week, after he had been presented with the Mond medal for "outstanding services to non-ferrous metallurgy" (*see* THE CHEMICAL AGE, January 30). Dr. Moore read a paper on "Co-operative Research in the Metal Industries," in which he pointed out that the United States was the acknowledged leader in industrial research with over 70,000 research workers, 2200 laboratories, and an estimated annual cost of 300 million dollars.

Dr. Moore then briefly mentioned the two research associations of the British iron and steel industry—the Cast Iron Research Association and the Iron and Steel Industrial Council—and went on to refer to the history, organisation, and activities of the British Non-Ferrous Metals Research Association, whose 340 members were producers, manufacturers and users of aluminium, copper, manganese, lead, zinc, etc. The last-named association, he said, served a large group of industries, and he attached real importance to the close and continuous contact with industry in research work. Liaison with industry was the peculiar function of the Development Department.

Common Problems

Touching on the future, Dr. Moore said that if the Government gave a greater degree of guidance to industry than before the war, then a national research association should play a key part. A research association was the obvious means for promoting extended co-operation, not by replacing the research associations of manufacturers concerned, but by undertaking work on large problems common to the industry and by co-ordinating research done in the laboratories of members. The non-ferrous metal industry would have to face new problems after the war, and its Research Association was the last body to remain in a static conditon, but was always seeking to improve its own methods of working. Three factors were essential to success; finance, staff, and co-operation. Success in research depended mainly on the quality of the staff and the training of metallurgists, and he emphasised the importance of a thorough knowledge of physics and chemistry as a foundation for a more detailed knowledge of metals. In concluding, he stressed the fact that the opinions expressed, were his own personal opinions.

S.C.I. Engineering Group

Vacancies on the Committee

NOMINATIONS for four new members to fill vacancies on the committee of the Chemical Engineering Group of the Society of Chemical Industry should reach the offices of the Group, 56 Victoria Street, S.W.1, not later than March 22. Such nominations must be signed by not less than three members of the Group, and no member may sign more than one nomination. The members to retire from the committee this year are: Dr. S. Baker, Dr. G. Bengough, Mr. F. W. Clark (lost at sea through enemy action), and Mr. W. Russell (at his own request). None of the above is eligible for re-election during the ensuing year. Members are reminded that the annual general meeting and luncheon of the Group will be held on May 19, at the Waldorf Hotel, London, W.C.2.

Maintenance of Pumps

Study Positions for Repairs

THE experience of makers of pumps handling corrosive liquids gained from repairing and the supply of spare parts is that these pumps often suffer badly from neglect for which the attendants can hardly be held responsible. Maintenance should be thought of before either the pumps or the tanks from which they have to draw are installed. It is characteristic of centrifugal pumps that they require to be flooded when starting up and this means placing the pump at a low level. It is false economy to place the pump in a small pit where it can be examined only with difficulty. If it must be put in a pit, the pit should be large enough to make it just as easy to examine as if it were at ground level. The whole of the outside of the pump should be examined periodically with a strong light. A leak from one of the joints may pass round to the lower side of the pump or to the baseplate and eat it away to an extent which needs replacement before the damage is noticed. Some leakage from the gland is, of course, to be expected, but this can be taken care of by a drip tray. A good deal can be done by coating the metal parts with enamel which will give some protection against corrosion by the particular liquid being handled, but the success of this or other precautions taken by the manufacturer is nullified if the pump is installed in a dark corner. Further, it is important in many cases that the pumps should be in a well-ventilated position, otherwise the moisture in the atmosphere will pick up fumes and these will be condensed on the metal of the pump.

Bearings and Glands

Apart from the prevention of leaks, maintenance consists mainly in attention to the bearings and the gland. The bearings for pumps of the class supplied by the Pulsometer Engineering Co., Ltd., are of the ball and roller type. The bearings themselves require little attention, but they are provided with close-fitting grease seals to prevent the entry of fumes and care must be taken to see that these seals are kept greased.

Finally, there is the stuffing box—a well-designed pump has the pressure behind the stuffing box reduced to a minimum so that it is not necessary to pull the gland down tight. Many liquids have a strong action on the packing which can be to a great extent reduced by the passage of water through the lantern bush between the rows of packing. It is, of course, wise to obtain a packing which is resistant to the liquid and, at the same time, not too harsh on the shaft sleeve. It may be here remarked that, apart from its immunity to corrosion, the extreme hardness of the sleeve of the Pulsometer-Doulton Stoneware Pump makes it a most satisfactory material, but in this case, as in all others, careful insertion of the packing is necessary for good results and this brings us back to our starting point, namely, that good maintenance begins in the lay-out of the plant.

It is not reasonable to expect that a pump attendant will be able to re-pack a gland to the best advantage if it has to be done in a cramped and uncomfortable position, particularly when it is remembered that the work often falls to the lot of an elderly man whose rheumatics may overcome his conscience. The ideal arrangement is to arrange the shaft at least at waist height and, if this cannot be done by putting the pump on a pedestal, it may sometimes be accomplished by making a pit alongside the pump.

Chemical Plant Valves

New Developments

VALVES are among the prime essentials of any chemical plant installation, and it is only natural that developments have taken place in the last twelve months. Products of the Audley Engineering Company, Ltd., continue to fill many needs of the chemical industry, and improvements have made them even more useful. Among these are the "Audco" Lubricated Glass Valve which was first introduced three years ago. It has now been modified in detail to make it more resistant to the effects of undue strain and shock. The plug head, previously in glass, and the most fragile part of the valve, is now made in metal, and the protective cage has been modified in detail to give even more protection to the valve proper. Stainless steel, used as a valve material, always has a tendency to seize and score. In the "Audco" Lubricated Valve this tendency was minimised by the film of lubricant between the seats, but not eliminated. For some five years the company has been coating the plug with a hard, welded-on facing which *does* eliminate this difficulty, and the process is now so firmly established that valves of this type have become a standard catalogue item, leaving the way open to the elimination of one more of the chemical engineers' worries.

"Audcoloy," the corrosion-resistant alloy iron, has also continued to prove its value, and valves in this alloy have solved many difficulties in the handling of sulphuric acid, the higher concentrations of caustic soda, free fatty acids, tar acids, and many other chemicals. It is also made as castings in pump parts, vessels, etc.

Neglect of Pipe Corrosion

Impregnated Wrapping Important

DESPITE the frequent attention given to pipe corrosion, both in the technical Press and in papers before scientific groups, there still exists a deplorable volume of either ignorance or indifference on this vital subject. Many engineers (gas, water, coke-oven plant and colliery), are too often content with coating a pipe with some mixture which has been "good enough" for previous generations, bury it and think no more of it until it gives trouble. Few ever think of investigating the type of soil in which they bury their pipe, and fewer still ever dream of taking *p*H readings. Yet, if the type of soil is thoroughly investigated and the appropriate steps taken, a main well laid can be forgotten.

In this connection an investigation made in Germany a year or so before the war was illuminating. Some 400 gasworks co-operated in a study of soils and pipe protection methods, and, as might be expected, the corrosion found could be ascribed to three well-defined causes: (1) Unsuitable ground conditions, so-called "aggresive" soils such as those containing acid, manure, and salt, made-up ground, marshy soils, clay soils and soils with changing water levels; (2) unprotected or inadequately protected pipe; (3) stray current from tramway systems and from faulty cables or conduits. Seventy-three per cent. of the works ascribed their difficulties to "aggressive" soils, yet only three per cent. of these made any attempt to study the soil or water in which their mains were laid. Even in these few cases, the investigations were limited to chemical analysis. Two only of the 400 works carried out *p*H measurements. The engineer, in the great majority of cases, had merely guessed whether the soil contained acids, salts or manure. It was also found that the same works would use tar, pitch, red lead, and asphalt-bitumen-jute without any apparent reason.

Protected Coatings

One reply to the questionnaire indicated the trouble taken by the average engineer to solve his corrosion problems. The reply read: "The corrosion experienced here is *probably* due to acids in the ground. The signs of corrosion are so strong that a steel main protected with jute, was completely destroyed within 10 years. In the same district cast-iron main had to be renewed within 12 or 15 years. The corroded cast-iron mains were in many places completely free of iron, only the graphite mass remaining, which could be sliced like cheese." A wide variety of protective coatings was employed by these 400 works. Among them were tar and pitch products, bitumen, paraffins, greases, and in some cases oils, paints, and varnishes. Many of the protective measures employed change their nature with time and some of them eventually have quite a contrary effect. An example is afforded by some greases used. In its original condition grease offers good protection. In time, however, it saponifies as it becomes rancid, giving off free fatty acids, which are active corroding agents.

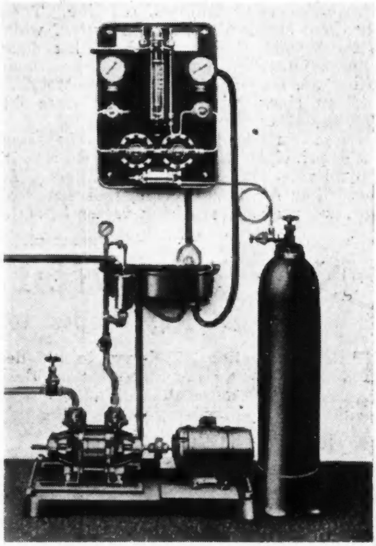
Many engineers have refused to employ textiles impregnated with grease, including hemp, jute and cotton. Other materials, such as tar asphalt and pitch, crack in time. Oils harden and therefore leave the pipe bare where the cracks inevitably form. Red lead paints, though excellent for the protection of surface steel, are not suitable for pipe laid in the ground. Some materials will not adhere properly to the smooth surfaces of steel and wrought iron pipe. In order to secure proper adhesion and adequate thickness of the protective agent, nearly all steel pipe is best wrapped with some impregnated material. Tarred paper, however, does not give lasting protection. Paper has not sufficient firmness and is not as supple as a textile. Tar is often used which is not of the so-called "prepared" variety, but contains ingredients which gradually change, such as light oils, naphthalene, tar acids, and sometimes water. Coal-tar protectives have thus been abandoned by many engineers in favour of special bitumens.

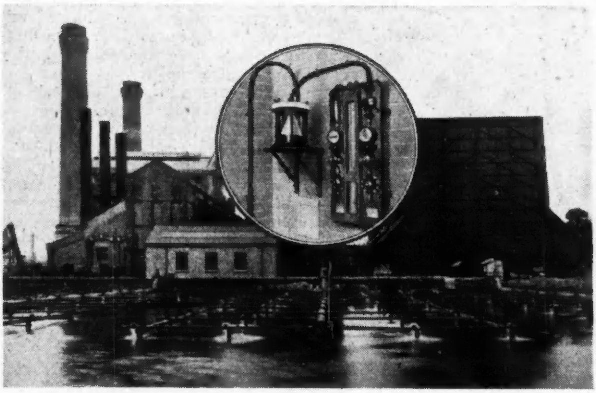
Textile Wrapping

The chemical agent alone has not always been responsible for poor protection, and a frequent cause is the improper degree of penetration of the textile wrapping used. If the hygroscopic properties of the vegetable fibre are not completely neutralised by thorough impregnation, moisture easily penetrates to the hollow stems of the fibres, and through the capillary action of these, penetrates gradually to the pipe itself. The well-known Denso type wrapping, consisting of an open-weave cotton, impregnated, and coated both sides with fully saturated petroleum hydrocarbons, fills a particularly wide gap in corrosion prevention. In this gap are pipes carried across railway or road bridges where they are exposed to locomotive smoke and stray currents from tramway systems, as well as the ordinary destructive qualities of the atmosphere. Such a wrapping is valuable for pipe which runs through brick or concrete walls, for the protection of welded joints. Protection of this kind, when properly applied, is found to be permanently non-absorbent of moisture and unaffected by vibration.

Chlorination of Cooling Water

Coal Economy at Power Stations





Above: Manometer C.M. Chloronome motor pump for chlorine solution treating of main water. Left: Typical Paterson "Chloronome" installation at a power station operated with cooling towers and pond.

AN important method of reducing the coal consumption at most power stations is sterilisation of the cooling water, using a measured trace of chlorine gas, generally not over 0.5 parts per million. This prevents the gradual deposition of algol growths on the condenser tubes, which form a non-conducting film that reduces the vacuum in the turbine, often to the extent of 1 in. or over after a few months, incidentally also of importance in connection with the efficient operation of cooling and condensing plant in the chemical industries.

It is difficult to arrive at average figures for the loss thereby caused because of the great variations in local conditions. Thus, much cooling water is extremely bad from the point of view of these growths, worse than the average, while variations in the weather play a part. The exact loss also caused by a reduction in the vacuum depends, for example, upon a number of factors such as the steam pressure and temperature of superheat and the load factor. Roughly, however, 1 in. drop in the vacuum, say from 29 in. to 28 in., corresponds to 5 per cent. loss in the annual coal bill. The fall in the vacuum is gradual but probably a rough average for all conditions throughout the year is that chlorination of the cooling water will save 3 per cent. of the coal bill per annum.

As showing the importance of this matter in the year 1940/41 the public supply electricity stations of Great Britain generated 32,349,000,000 units and burned 19,817,000 tons of coal. The complete utilisation of chlorination plant would therefore save something like 550,000 tons of coal per annum, because of an average higher vacuum at the turbines. In this connection great interest attaches to the work of the Paterson Engineering Co., Ltd., of London and Calcutta (10 Clive Street), the pioneers of the sterilisation of cooling water, who installed the first plant in the world in 1922 at a well-known London power station. The

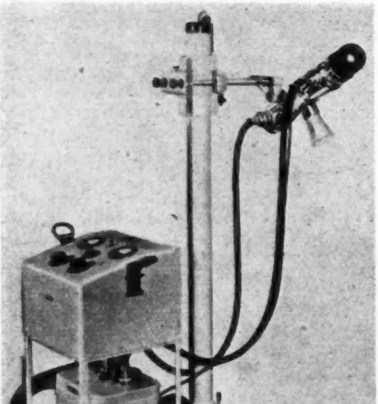
firm have since installed plants at a large number of prominent power stations and industrial plants in Great Britain and other countries, and use for the purpose one or other of the modifications and types of their "Chloronome" apparatus in conjunction with cylinders or drums of chlorine. There are three standard types, the first of which is the "Pulser" in two sizes with a maximum chlorine output of 0.4 lb. per hour, whilst the second is the "Manometer," in thirteen sizes, with a capacity from 0.5-30.0 lbs. of chlorine per hour.

These instruments are on the same basic principle, being a metal panel with control valve, pressure gauges, metering device, filter for the chlorine, moisture seal, and two pressure reducing valves in series coupled up to the supply of chlorine by narrow diameter flexible copper tubing. In this way the chlorine gas is admitted continuously at any desired controlled rate, passing into a stoneware tower to make a relatively strong solution in water, which is then discharged to the cooling water to ensure rapid and uniform mixing. There are several installations running at power stations with a capacity of as high as 240,000,000 gallons of cooling water per 24 hours and over. There are also quite a number within the range of 60,000,000-240,000,000, and in addition all sizes of plant down to below 24,000,000 gallons. Apart from the important saving in coal, very valuable is the saving in labour and the improved utilisation of important plant.

New Industrial Maintenance Unit

X-Ray Inspection of Alloys and Steel

THE application of X-rays to non-destructive testing and inspection problems has now become an established procedure in a wide variety of industries. One of the most



widely known of the various uses is, perhaps, the inspection of light alloy castings. Hidden flaws and porosities are brought to light as a matter of foundry routine and before any wasted expenditure on machining. Indeed, for castings which are designed to withstand high stresses the X-ray test is the only practicable method of quality control. Among fields of application may be instanced the inspection of welded structures, finished assemblies of various kinds, electrical components, plastics, fabrication processes in wood, and other materials, and the inspection of articles believed to have been damaged or over-stressed in service.

The new "Macro 100" Industrial X-ray unit manufactured by Messrs. Philips Lamps, Ltd., Century House, Shaftesbury Avenue, London, W.C., is suitable for the radiographic examination of aluminium alloys up to 4 in. thick, up to 1 in. visually, and all thicknesses of magnesium both radiographically and visually that occur in practice. For the examination of steel such as welds, the radiographic penetration is $\frac{5}{8}$ in. It is claimed that the unit is simple to operate, completely safe, and robust enough to stand up to the wear and tear of factory and laboratory routine. The apparatus consists of a ray-proof and shock-proof X-ray tube fed from a compactly designed H.T. transformer to which it is connected by means of shock-proof flexible cables. The control system is arranged as a separate unit and takes the form of a portable control desk which is coupled to the H.T. transformer by means of a flexible connecting lead.

Except in instances where the "Macro 100" is employed in conjunction with a conveyor system of examination, the equipment is mounted on a mobile base which carries the H.T. transformer, control desk and also the tube stand. The latter is provided with a counterpoised movement to facilitate easy vertical adjustment. The X-ray tube is mounted on a cross carriage of double tubular design provided with all the necessary locking devices.

Shock Absorption Problems

New Service by Yorkshire Firm

AN important new service is now offered by Listers, of Bradford, in dealing with vibration. Known as Resilitex, it is the successful application of a familiar textile principle to a new and urgent purpose, and like many other revolutionary industrial discoveries, it is the result of a new train of thought and an unexpected association of ideas. Resilient and with many other innate advantages, Resilitex provides an entirely new approach to the problems of de-vibration, shock absorption, and insulation. It is not a synthetic, and is not a substitute, but it gives an almost identical performance to that of sponge-rubber and has, moreover, certain definite and specific advantages. It is manufactured in this country and is freely available for any officially approved contract. Resilitex is in wide use to specification by the Ministry of Aircraft Production, the Ministry of Supply, and the Admiralty, and has come into being at the time when it is most needed.

Although Resilitex is on the secret list, its composition cannot be disclosed, it is at present produced in five grades and these are numbered in order of decreasing resilience, 10, 20, 30, 40, and 50. For standard purposes it is made in unit sheets, 20 yards long, 48-50 in. wide and 0.3 in. thick. The sheets can be bonded together with fireproof cement to give any desired thickness. Whether used as a standard unit or bonded, it can be cut to almost any shape or size and can be bent round curves or angles, or shaped as a moulded core. Though the standard unit is 0.3 in, thicker or thinner sheets can be woven for special purposes. It is clear that the versatility of Resilitex makes it suitable for de-vibration, shock absorption and various types of insulation in every field of industry. New uses are being found for it daily and its scope appears to be almost unlimited.

Its Properties

In addition to its resilience, it has other innate properties. Resilitex is porous to air, but an impermeable coating can be applied to the exterior surface. It breathes freely and does not sweat. Petrol and oil do not affect it, but it is unsuitable as a container for liquids. It can be boiled in water for two hours without any adverse effect. As pads are usually upholstered in a water-repellent material, the natural finish is normally sufficient, but a waterproof finish can be given to it, if desired. A special process enables a thin covering of sponge-rubber to be applied, which seals the cut edges, as well as preventing ingress of water. Resilitex is very light in weight, and comparison with a sponge-rubber sample of approximately the same per cent. compression, indicates that it is about half the weight for the same resilience. This is an important point, particularly for aircraft work. The School of Tropical Medicine, London, gives an opinion that it should not harbour lice—pests which do not eat textile fabrics and do not burrow into pile.

The ability of Resilitex to retain its characteristics over a long period of time is exceptional. It has passed heavy transport tests*, where the pressure applied was 280 lb. per square foot, at the rate of 63 beats per minute for 150,000 depressions. At the end of this test, the Resilitex pad was in new condition and showed no measurable set.

Fixing

For thermal insulation, Resilitex has excellent heat insulating properties. A fireproof finish is given to all standard qualities, and anti-moth finish can also be applied. By a special method of building up, lattice and honeycomb structures can be produced, thus further reducing weight for resilience. Research also shows that a combination of these honeycomb structures with a spring casing has brought satisfactory results in certain types of cushioning. Cements are available for fixing it upon wood, metal, or other structural material. Owing to its construction, the cut edges tend to become hairy, but this is of no importance if the pad is to be upholstered or covered, but in some cases it is preferable to seal the edges by (a) dipping the cut edge in a weak solution of gum, *e.g.*, gum tragacanth, to prevent fraying in transit or in light use; (b) binding the edges, passe-partout fashion, with a strip of light-weight cloth, a treatment suitable for permanent work; and (c) totally enclosing the shaped article in a thin film of sponge-rubber. The development of Resilitex has been rapid. It is now being produced on a large scale for seating materials; mattresses; shock pads as protection for heads and limbs against concussion; shock insulators around instrument eyepieces, etc.; mounting for instruments, apparatus and equipment; packings for delicate instruments, valves and medical supplies; shoulder pads, and for carrying heavy equipment.

Managers facing a probable breakdown connected with vibration, shock absorption, etc., are invited to send their problems to Listers' Research Department.

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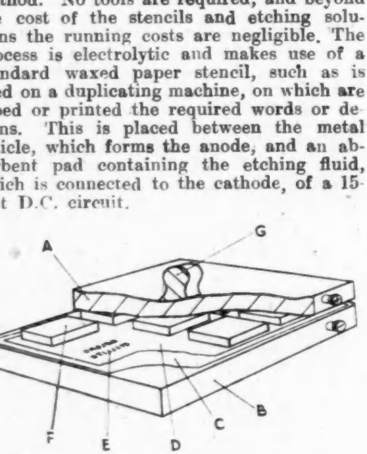
* Tests were carried out with two different pads of Resilitex: (a) 3-ply pad, 3$\frac{3}{4}$" at rest and compressed by $\frac{3}{4}$" to 2$\frac{1}{2}$" under load; (b) 2-ply pad, 2$\frac{5}{16}$" at rest, compressed by $\frac{5}{16}$" to 1$\frac{1}{2}$" under load.

Etching on Metals

Easily Operated New Method

A NEW process (patent pending), developed by the Deloro Smelting & Refining Co., Ltd., Birmingham, provides a cheap and simple method of etching trade marks, numbers, or designs on to the surface of metals. The method is rapid and gives pleasing results particularly on hard or stainless alloys such as high-speed steel, stainless steel, etc. It can be applied to brass, nickel, indeed to any metal. It enables a number of small articles to be etched in the same time as taken for one artcle; and a whole sentence can be etched as rapidly as one word. It has no limitations in the complexity of the design which can be transferred, provided only that a stencil can be cut. Awkward shapes lend themselves particularly to etching by this method. No tools are required, and beyond the cost of the stencils and etching solutions the running costs are negligible. The process is electrolytic and makes use of a standard waxed paper stencil, such as is used on a duplicating machine, on which are typed or printed the required words or designs. This is placed between the metal article, which forms the anode, and an absorbent pad containing the etching fluid, which is connected to the cathode, of a 15-volt D.C. circuit.



An illustration of the main features of the apparatus is shown herewith. It consists of a unit comprising transformer, rectifier, and output controller, which gives a potential of 15 volts D.C. from the 200/230 volts A.C. supply. " B " is a graphite base plate connected to the negative terminal of the D.C. source. On the surface of this block rests a pad " C " which may be a few layers of ordinary blotting paper. This pad is damped with the etching fluid and the typewritten, or hand drawn, or otherwise imprinted stencil " D " is then placed face downwards on it. The metal object " F " which must have a flat, but not necessarily polished, surface is then placed face downwards on the stencil. Electrical contact and pressure are provided by placing on top of the metal the weighted graphite block " A " which is connected to the positive terminal of the D.C. source. The current is then turned on for a period varying from 5 seconds for a small design to 10 seconds for a larger one, or even 30 seconds where, say, 20 metal objects are being etched at once. The current varies from 2 amps. up to approximately 10 amps. for a large number of articles. It is important in the latter case that sufficient mechanical pressure is maintained to ensure good contact with each specimen. In placing a specimen on the stencil no part of it should touch the bare pad, otherwise it will become etched. It is not necessary for the surface of the metal article to be free from grease before engraving since greasy surfaces etch quite well. When etching stainless or corrosion-resisting metals, each cut in the stencil is good for at least 15 etchings, the life being limited by the tendency of the stencil to become burned, and the etching to become blurred. The life of the stencil is reduced to about 10 engravings with less corrosion-resisting metal such as mild steel, as the dielectric properties then become impaired.

The normal depth of the engraving is about .0005 in. and the structure of the adjacent metal is in no way altered, nor is the surface of the metal embossed, but remains perfectly flat. The etching appears as a silvery colour on mild steel and is more brilliant on stainless metals. It can be filled afterwards, if desired. Round or curved articles can be rolled over the stencil while in contact with the top block, and awkwardly-shaped or large articles can be etched by fitting the waxed stencil to the curved face of a hand blotting-pad and making the necessary electrical connections to the metal body of the hand blotter and the article. The apparatus is obtainable from Messrs. Griffin & Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2, to whom all inquiries should be addressed.

Irish cattle are providing the raw material for a number of pharmaceutical products in short supply in Eire. A new company, National Chemical Industries, Ltd., is now producing, from this source, liver and pancreas extracts, adrenalin, vaccines, and sera, and, in addition, is proposing to extend its activities to the growing of herbs for the manufacture of drugs such as digitalis and belladonna. It is stated that the soil and climate of S.W. Ireland are particularly suited to the growth of the required herbs.

Welding Brasses and Bronzes

Some Fusion Methods Described

RECENT developments in the application of brasses and bronzes, particularly the rapidly increasing use of extruded parts as well as castings and forgings for ornamental work, have focussed attention on the fusion welding of these alloys. For general industrial purposes, bronze welding is widely adopted to produce perfectly satisfactory joints in most of these alloys. For the more recent applications, particularly in ornamental work, fusion welds are often preferable, and, in some cases, the only type of welding possible. To be satisfactory for this work the welds must have certain definite characteristics; the weld metal must be perfectly sound and free from porosity so that the joint will not be perceptible on a polished surface, and the weld metal must, in many instances, not only match the colour of the base metal at the time of the welding, but must follow any changes in tone which occur in the base metal on exposure or weathering.

The technique formerly used for the fusion welding of these copper base alloys did not produce results that were entirely satisfactory for these newer applications. An exhaustive investigation of this problem resulted in the development of suitable methods for producing sound fusion. In general, when oxyacetylene is used, the production of high-quality fusion welds in these alloys depends on the use of a welding flame containing an excess of oxygen. The exact adjustment of the flame varies with the different alloys. The brass alloys are those in which copper and zinc are the essential components, the zinc content ranging from 15 to 40 per cent. Ordinary machine brass contains from about 60 to 68 per cent. of copper and 32 to 40 per cent. of zinc, whereas the red brasses contain from 75 to 85 per cent. of copper, the remainder being zinc. Intermediate alloys frequently contain 1 per cent. or more of tin, manganese, iron, or lead.

Avoidance of Porosity

A bronze may be of almost any copper base composition, but as a rule this term is reserved for alloys containing relatively high percentages of tin and lead, with or without small amounts of zinc. Typical compositions are 90 per cent. of copper and 10 per cent. of tin; 85 per cent. of copper, 5 per cent. of tin, 5 per cent. of lead, and 5 per cent. of zinc; and 88 per cent. of copper, 10 per cent. of tin, and 2 per cent. of zinc. In addition, there are a number of miscellaneous alloys, such as those containing various amounts of nickel, which give the alloys a whiter colour. Practically all of these compositions are found in either cast or rolled condition, and a number of them are extruded into a wide variety of special shapes. As has been indicated already, welds in any of these materials must perform certain functions. Occasionally the tensile strength of the weld is an important factor, but generally for welds in these classes of materials, the soundness or freedom from porosity and the colour of the weld metal, are important conditions. In welding castings it is essental that the colour of the deposited metal should match the colour of the base metal, and that the weld be equally as sound as the base metal. Extruded shapes are not usually subjected to much stress, but, here again, it is essential to match colours and eliminate all porosity so that the joint will not be evident when the surface is given a high polish.

Difficulties Encountered

All these alloys are similar in exhibiting an unsatisfactory behaviour when welding is attempted with a neutral blow-pipe flame. In some of the brasses the zinc distils off in heavy clouds when the alloys are melted; while with the alloys containing some lead it is very difficult to attain a fluid condition of the base metal, because lead melts out and covers the surface, making it difficult to melt the welding rod into it. When bronzes high in tin or lead are heated certain constituents melt and exude from the metal at a temperature considerably below the melting point of the alloy. These metals, both brasses and bronzes, boil when melted with a neutral flame. This condition is conducive to the development of gas inclusions, so that porosity becomes a characteristic of the weld metal produced when these alloys are welded with a neutral flame. For some time it has been known that by using a properly adjusted oxidising flame instead of a neutral flame, the porosity of the deposited metal could be considerably reduced.

When welding brass, if the base metal is brought almost to the melting point by means of the neutral flame, it will be noticed that zinc fumes start coming off and that the surface of the metal is rather bright. If the flow of acetylene is then gradually reduced, or the flow of oxygen increased gradually, it will be noticed that at a certain point of excess oxygen flame adjustment a distinct coating is formed on the surface of the brass. The flame adjustment for this is strongly oxidising. Increasing the oxygen in the flame beyond this point should

be avoided, as the coating or the film would then become so very thick and refractory that it would interfere with welding. By using the oxidising flame adjustment which just begins to produce the film—that is, when the coating just becomes visible—the boiling and fuming of the base metal will be practically eliminated. This is the point at which the very best weld, free from porosity and of good tensile strength, is produced. Owing to the formation of the coating on the molten puddle, it is necessary to use a suitable flux whether any rod metal is being added or not. The flux is best applied by mixing with water to form a paste which is painted on the rod and on the base metal along the scarf. Either forehand or backhand welding may be used, although, as a general rule, forehand welding will produce more satisfactory results. It is necessary to keep the surface well fluxed so that it will not be necessary to force the weld into the puddle. The metal and the rod should not be overheated, as this will cause fuming of the zinc of the alloy and result in an inferior weld. When fusion-welding the bronzes which contain relatively high amounts of tin or lead, or both, it will be observed that these constituents start boiling out before the base metal is even at a red heat. By using a strongly excess oxygen flame, however, for both the preheating and the welding, this tendency for boiling out of tin and lead is eliminated.

Correct Flame Adjustment

After the base metal has melted and there is a noticeable film on the surface of the molten puddle, the amount of excess oxygen in the flame should be varied over a fairly wide range. During this it will be found that for one particular flame adjustment the film or coating tends to disappear and a bright surface is maintained on the metal. This is the correct flame adjustment necessary for good welding of the high-tin, high-lead copper alloys. Usually a few preliminary trials will determine this adjustment, and once found, welds free from holes or gas inclusions and with well-distributed tin and lead content can be made. With alloys containing relatively large amounts of lead, say, over 5 per cent., some difficulty may be encountered due to the excessive formation of lead oxide, but by the use of an abundant quantity of flux painted on the welding rod this will be largely eliminated. The same fluxes as used for fusion-welding of brass are found to be most satisfactory. Very little difficulty should be encountered in the welding of rolled or extruded brasses or bronze, because almost any of these alloys that have previously been subject to hot work during forming have good strength during welding conditions. There are a few complex casting alloys, however, which may require special care, particularly when welding restrained areas, as these alloys have very little resistance to hot work and to stress at high temperature. Proper preheating will assist materially in relieving stresses in the base metal and this will permit the production of good sound welds.

Complex Compositions

The most satisfactory way to learn to weld these complex brass and bronze compositions is to obtain samples and experiment with different flame adjustments to determine proper conditions. Consideration must be given to joint design, and the method of holding parts of welding. Where a hairline is not objectionable on the surface, welding can be done from the back. The two parts are clamped tightly together without veeing, a tack-weld is made at one end of the seam, and welding is started at the other end. This type of joint has the advantage of not requiring any finishing. Where hollow sections are joined, welding must usually be done from the front. The edges of the seams are usually veed before clamping the assembly in position for welding. In order to simplify the finishing operations the weld should be made with only a slight reinforcement, taking care to avoid any low spots.

LEAD SOLDER COMPOSITIONS

Research work in the laboratories for substitute soldering compositions to take the place of pre-war mixtures in order to conserve tin, has resulted in a generally increased use of lead through the raising of the lead content. In a recent issue, *Railway Age* points out that an example of this is the substitution of a 70 per cent. lead, 30 per cent. tin alloy for the former 50-50 tin-lead solder (usually 40 to 45 per cent. tin) so commonly used in normal times for all soldered joints in electrical equipment manufactured by the railway industry. The substitute is not as satisfactory in some respects as the former 42 per cent. tin alloy but has been found to be "reasonably good." A new solder containing 15 per cent. tin, 1 per cent. silver, and 84 per cent. lead, known as Westinghouse alloy, has the essential characteristics of a solder containing 15 per cent. tin and 85 per cent. lead, plus a slight increase in "solidus" temperature through the addition of silver. It has a melting range of 233° to 273°C., and may be used either for hand soldering in wire and ribbon form or for pot soldering of large commutators. A satisfactory job can be obtained with neutral flux. Because of its higher flow point (273° as against 232°C. for pure tin) it is necessary to operate solder pots at higher temperature and to use hotter irons.

Phthalic Anhydride in Canada

An Addition to the Dominion's Chemical Industry

ONE of the many chemicals newly produced in Canada since the beginning of the war is phthalic anhydride. It is being manufactured in a modern plant, owned and operated by the Dominion Tar & Chemical Co., Ltd. This company for many years has been interested in various by-products of coal-tar distillation, producing, among other products, large quantities of naphthalene. The production of phthalic anhydride followed as a natural development. The plant was built in 1941, as one of the projects of the Allied War Supplies Corporation, whose assistance in securing the necessary construction materials, and whose engineering advice and help is gratefully acknowledged.

Phthalic anhydride is produced by the catalysis of the vapour phase reaction between naphthalene and atmospheric air. Molten naphthalene is stored in a measuring tank mounted on a platform scale tared for the weight of the tank, so that the scale gives a direct reading of the weight of naphthalene. The measuring tank is filled once a day, and from it the naphthalene is fed as required into a vaporiser. A stream of preheated air is blown through the vaporiser where a saturated mixture of air and naphthalene is produced. The temperature, pressure and flow of this primary air stream must be accurately known and regulated, as this is the process which introduces the naphthalene into the system. The mixture leaving the vaporiser is within the explosive range and is considerably too rich in naphthalene to be passed through the converter. By the addition of a secondary supply of air, the mixture is diluted and the leaner mixture—now outside the explosive range—is then passed downward through a multiple-tube single-pass converter containing vanadium pentoxide catalyst. The gases pass through a multipass heat exchanger, operating as a waste heat boiler, where they are cooled down to within a few degrees of the dew-point of the mixture before proceeding into large cooling chambers where the crude product condenses as a bulky mass of long needle-like crystals.

Low-Pressure Heating

The crude material is removed manually from the condensers once a day. It is transferred to a Dowtherm jacketed tank in which enough molten phthalic anhydride is accumulated to charge a vacuum still, also Dowtherm jacketed. The use of Dowtherm heating permits the attainment of temperatures in the neighbourhood of 300°C., at pressures of not more than 50 lb. This low pressure permits a much lighter design of the jackets and vessels than would be possble if higher pressures were required to secure the necessary temperatures. The charge is first refluxed at atmospheric pressure for several hours to decompose any phthalic acid present and to effect the polymerisation of impurities left behind as a residue of the distillation. The charge is then distilled under an absolute pressure of 2 to 3 inches of mercury. The vapours pass upwards from the still through a packed column and thence into a condenser cooled by water boiling under pressure. The height of the condenser is such that the liquid phthalic anhydride flows into a barometric leg and thence to a water-cooled flaker. From the flaker the pure product is packed directly into paper bags or wooden barrels. All equipment coming in contact with the vapour or the pure phthalic anhydride liquid is of stainless steel construction.

Control of Reaction Conditions

Theoretically, the heat of oxidation of the reaction amounts to 5460 B.Th.U. per lb. of naphthalene oxidised. Some complete combustion takes place, with the result that the heat acually liberated per lb. of naphthalene is about 10,000 B.Th.U. This heat must be dissipated without disturbing the equilibrium conditions of the reaction. The actual temperature and the contact time required are dependent on the condition of the catalyst. To low a temperature or too short a contact time will lead to underoxidation; whereas the other extreme will allow combustion to take place. According to the degree of oxidation, the possible products range through a series: unconverted naphthalene; the addition of oxygen to the naphthalene ring with the formation of naphthaquinones; the destruction of the naphthalene ring on production of phthalic anhydride; the subsequent splitting off of carbon dioxide to form benzoic acid; further oxidation combined with the breakdown of the benzene ring, giving maleic anhydride; and finally complete combustion to carbon dioxide and water.

To maintain a satisfactory output of the desired product, it is necessary to be able to control the temperature and contact time at the optimum levels. The method used on the plant under discussion involves a bath of boiling mercury. The converter consists of a vertical steel shell containing a large number of tubes of square crosssection. These are held apart top and bottom by spacer bars and are all interconnected by continuous welding which forms the equivalent of the top and bottom tube sheets. Each tube is surrounded by mer-

cury. The standard square cross-section was chosen because it gives a maximum of heat exchange surface with a minimum of free space between the tubes. This latter point is important because of the high cost and weight of mercury. Just below the top "tube sheet," eight vertical air-cooled reflux pipes are connected into the mercury space. During operation of the converter the mercury is boiling under total reflux. To adjust the temperature of the boiling mercury and thus the reaction temperature itself, the tops of the reflux pipes are interconnected by a circular pipe which leads to a carbon dioxide cylinder. By this means a pressure is superimposed on the mercury to maintain the desired boiling point. To start the process up to the point where the heat of the reaction is sufficient to maintain the required temperatures, it is necessary to provide external heat. This is done by means of electrically heated plates which are ground to fit on the outside surface of the converter. As soon as the process is under way these are shut off. The liberation of heat at the converter is of very considerable magnitude. It is not considered wise, however, to complicate the equipment to the extent required to recover this heat.

Contact time is controlled by suitable changes in the pressure of the reaction mixture itself. These are effected by manual control of a valve situated in the gas stream between the converter and the vapour cooler. Thus any desired reaction pressure up to the pressure of the air supply is maintained ahead of the valve, whereas behind the valve the only pressure is that due to the resistance of the vapour cooler and the condensers which exhaust to the atmosphere.

Phthalic anhydride is strictly an intermediate chemical. It is used extensively in the manufacture of anthraquinone and derivatives using the Friedel-Crafts reaction. It is also a raw material for many other dyes. Some quantities go into the manufacture of phenolphthalein. Another outlet is the production of chloride-free benzoic acid. The largest part of the production, however, is devoted to the esters and resins, many of the phthalate esters being very valuable plasticisers. Reaction with glycerol gives the glyptal-type resins used in the manufacture of lacquer

The total present production of phthalic anhydride is being devoted to the immediate needs of the war. There can be no doubt, however, that the continued production of this important intermediate in peace time will be a forward step in the building up of a more complete Canadian chemical industry.—*Canadian Chemistry and Process Industries*, January, 1943.

Paint Standards Revised

Oil Gloss Paints

A REVISION of the War Emergency Specification for Oil Gloss Paints, just issued by the B.S.I., as 929/1943, has been carried out to effect the necessary modifications arising from the changed position in regard to the supply of paint materials. The scope of the specification has been extended and now covers a range of priming paints with different white pigments as base, *e.g.*, white lead, zinc oxide, lithopone, and titanium dioxide. Opportunity has been taken to modify the reference letters used for these paints: the priming paints are designated with the letter "P," the undercoating paints with the letter "U," and finishing paints with the letter "F." Another alteration is that the restriction on the percentage of calcium salts has been deleted.

A further important modification is the restricted range of colours which are now specified for paints for general purposes. This is limited to 18 colours together with black and white, apart from colours used by Services Departments.

Traffic Paint

A revision of BS/ARP 38, Traffic Paint, issued by the B.S.I., has been necessary owing to the change in the supply position of paint materials. The previous specification provided for a Type 1A paint which required the use of methylated spirit for its manufacture, but this is now no longer available. The new specification includes four types of paint for road marking:

Type A.—A methanol/resin paint which can be applied to the road surface at any period of the year.

Type B.—An oil paint which can be applied at any time of the year, but is only suitable for application to surfaces which have not a heavy coating of bitumen on them.

Type C.—A water paint with special wearing properties.

Type D.—An ordinary water paint.

Paints to Types C and D are not suitable for application under winter conditions. As, however, the materials used in their manufacture are not subject to the same restrictions as the materials for Types A & B they should be used wherever practicable. Two other types of paint, E and F, are also provided for painting road obstructions such as lamp posts, trees, etc. The specification includes details of the tests with which each of the types must comply.

Copies of the above specifications are obtainable post free from the British Standards Institution, 28 Victoria Street, London, S.W.1; B.S. 929/1943, price 2s., B.S. ARP/38, price 8d.

Personal Notes

MR. L. A. ELGOOD, secretary of the Distillers Co., Ltd., has been appointed a director of the company and retains his office as secretary.

MR. W. M. WATKINS, analytical chemist with the National Smelting Company, Swansea, until he joined the R.A.F., has obtained his "wings" overseas.

MR. HAROLD JOSEPH GORER and MR. LESLIE ERNEST WAKEFORD have been appointed additional directors of Lewis Berger and Sons, Ltd., with effect from March 1. These appointments fill existing vacancies on the board.

MR. ROBERT A. MACGREGOR, who for many years was chief metallurgist at Darlington Forge until going to India eight years ago, has been appointed C.I.E. in recognition of his work as chief metallurgist at the Department of Supply, Calcutta.

MR. GREVILLE S. MAGINNESS has been appointed to succeed MR. GEORGE BAILEY as president of the Engineering and Allied Employers' National Federation. He is on the boards of Roneo, Tube Investments, and Churchill Machine Tool (managing director).

MR. M. F. ANDERSON has been appointed general manager of Naugatuck Chemicals, Ltd., Elmira, Ont., and of the Chemical and Regenerating Division of Dominion Rubber Company, Ltd., Montreal. Mr. Anderson continues as director of development with headquarters in Montreal.

Obituary

MAJOR GEORGE S. M. COLBECK-WELCH, a director of Hickson and Welch, Ltd., Castleford, has died at Collingham Bridge, aged 59.

MR. HORACE WATT RENNIE, a director of C. Holden and Company, Ltd., and partner in the firm of James Rennie and Company, died at his home, Hazelwell, near Birmingham, on March 2, aged 76. Mr. Rennie trained as a metallurgical chemist and had been assayer of metals to the Pahang Corporation.

PROFESSOR JOHN EUSTACE, B.Sc., A.R.S.M., A.M.Inst.C.E., who died at Southampton on February 24, aged 78, was distinguished as a metallurgical and mining engineer. A native of Camborne, and educated at the Royal School of Mines there, he was a Whitworth Scholar and a National Science Scholar. From 1892 to 1931 he was head of the Engineering Department of University College, Southampton, where he had also served as Vice-Principal. As technical director of the Austin Motor Company, he organised the works school in 1917-18.

MR. HARRY GEORGE SEIDEL, who lost his life in the recent Yankee Clipper crash, had been a director of the Standard Oil Company and the Iraq Petroleum Company, and president of the International Association (Petroleum Industry), Ltd.

PROFESSOR HENRY GEORGE DENHAM, M.A., D.Sc. (Liverpool), Ph.D. (Heidelberg), F.I.C., whose death at the age of 62 has been reported from New Zealand, had been Professor of Chemistry at Canterbury University College since 1923, and Rector of the college since 1941. He was also Chairman of the New Zealand Council of Scientific and Industrial Research, and as recently as January 4 received the high honour of election to honorary membership of the Society of Chemical Industry. In 1912-21 he was on the staff of the University of Queensland, and then was appointed Professor of Inorganic Chemistry at Cape Town. He was a Past-President of the New Zealand Institute of Chemistry.

CHEMICAL WORKERS' TOWELS

A double ration of coupons for towels, in the period to December 31, 1943, is permitted to workers engaged in chemical manufacture, chromium plating, clay works, dyeing, lead smelting, luminising, oil-cake mills, paint and colour manufacture, tanning, hollow-ware tinning, tin or terne plating, and vitreous enamelling (among numerous other trades): also workers (not included in the above) liable to come into contact with explosives, cutting oils, soldering flux, synthetic glue, or other substance (to be named in the application) involving risk of dermatitis. Application for these rations should be made, *by the factory occupiers only*, who should write to their District Inspector of Factories asking for Form M.L.2050.

RAW MATERIALS GUIDE

The Ministry of Supply has issued a new handbook called the "Raw Materials Guide." It is hoped that this booklet will be of assistance to business men and traders and others interested who may in the past have experienced some difficulty in finding out exactly what the law is relating to particular raw materials. So many statutory rules and orders have been issued that it is extremely difficult for anyone to remember them all. The new guide tells what the raw materials are, what they do, gives particulars of their control and of the statutory rules and orders that have been issued about them. It is proposed to issue monthly addenda of any changes. Nearly 1000 different raw materials are dealt with in this guide, which is issued by H.M. Stationery Office, and is also obtainable through any bookseller, price 1s.

Prices of British Chemical Products

CONTINUED active trade is reported this week in virtually all sections of the industrial chemicals market, although in some directions actual quantities on offer for new business are, of course, restricted by the limited supplies available for other than priority needs. Makers' contract deliveries are on a good scale and fairly substantial quantities are reported to be going into consumption. The tone of the market throughout is firm and there is a tendency for quotations to be higher, although no actual price changes fall to be recorded. The demand for the majority of the soda products is steady; soda ash, salt cake and Glauber salt are in brisk demand and nitrate of soda is a good market. In the potash section there is a good inquiry for the limited supplies of some materials, including bichromate of potash, caustic potash, permanganate of potash, and yellow prussiate of potash. In other directions formaldehyde is a good market as are also borax, white powdered arsenic, and the majority of the heavy acids. There is no change to report from the coal-tar products market this week.

MANCHESTER.—While there has been no easing of the pressure for contract supplies of chemicals from most of the leading consumers in and around Manchester, no big weight of new buying locally either on home or export account has been reported. The soda products as a whole are being taken up in fair quantities and offers of the potash chemicals, which are generally restricted, are finding ready outlets. Carbonate of ammonia and other ammonia compounds are being called for in fair quantities. Taking the chemical market as a whole, quotations are on an extremely firm basis. There is a steady absorption of most descriptions of tar products against contracts, but local reports as to new business have been variable.

GLASGOW.—There has been a slight improvement in the position in the Scottish heavy chemical trade during the past week for home trade. Export business remains rather restricted. Prices continue to be very firm with no actual changes.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton £39 10s.; 10 cwt./1 ton, £40 10s., 4/10 cwt., £41 10s.; 80% pure, 1 ton, £41 10s.; 10 cwt./1 ton, £42 10s.; 4/10 cwt., £43 10s.; commercial glacial, 1 ton, £49; 10 cwt./1 ton, £50; 4/10 cwt., £51; delivered buyers' premises in returnable barrels, £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £14 10s. per ton, f.o.b.

Aluminium Sulphate.—£10 15s. to £11 5s. per ton d/d.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Carbonate.—£38 to £39 per ton d/d in 5 cwt. casks.

Ammonium Chloride.—Grey galvanising £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. See also Salammoniac.

Antimony Oxide.—£111 to £117 per ton.

Arsenic.—For 1-ton lots, £41 to £46 per ton, according to quality, ex store. Intermediate prices for intervening quantities.

Barium Carbonate.—MANCHESTER: precip. (4-ton lots), £16 per ton d/d.

Barium Chloride.—98/100%, prime white crystals, £16 10s. to £19 10s. per ton, bag packing, ex works; imported material would be dearer.

Bleaching Powder.—Spot, 35/37%, £11 to £11 10s. per ton in casks, special terms for contract.

Borax, Commercial.—Granulated, £31 10s.; crystals, £32 10s.; powdered, £33; extra fine powder, £34; B.P. crystals £40 10s.; powdered, £41; extra fine, £42 per ton for ton-lots, in free 1-cwt. bags, carriage paid in Great Britain. Borax Glass, lump, £83; powder, £84 per ton in tin-lined cases for home trade only, packages free, carriage paid.

Boric Acid.—Commercial, granulated, £52 15s.; crystals, £53 15s.; powdered, £54 15s.; extra fine powder, £56 15s.; B.P. crystals, £61 15s.; powdered, £62 15s.; extra fine powdered, £64 15s. per ton for ton lots in free 1-cwt. bags, carriage paid in Great Britain.

Calcium Bisulphite.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton, ex store.

Charcoal, Lump.—£10 10s. to £14 per ton, ex wharf. Granulated, supplies scarce.

Chlorine, Liquid.—£23 per ton, d/d in 16/17 cwt. drums (3-drum lots).

Chrometan.—Crystals, 5½d. per lb.

Chromic Acid.—1s. 5d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6¾d., other, 1s. 5d.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Copper Oxide.—Black, £95 per ton.

Copper Sulphate.—£31 5s. per ton, f.o.b., less 2 per cent. in 2 cwt. bags.

Cream of Tartar.—100%, £18 12s. per cwt., less 2½%, d/d in sellers' returnable casks.

Formaldehyde.—£24 10s. to £26 per ton in casks, according to quantity, d/d. Manchester: 40%, £24 10s. to £26 10s. per ton in casks, according to quantity, d/d.

Formic Acid.—85%, £47 per ton for ton lots, carriage paid; smaller parcels quoted up to 50s. per cwt., ex store.

Glycerine.—Chemically pure, double distilled 1260 s.g., in tins, £4 to £5 per cwt., according to quantity; in drums, £3 14s. 6d. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 6s. 5½d. to 8s. 11d. per carboy d/d according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Iodine.—Resublimed B.P., 10s. 4d. to 14s. 6d. per lb., according to quantity.

Lactic Acid.—Pale tech., 43½ per cent. by weight, £49 per ton; dark tech., 43½ per cent. by weight, £42 per ton ex works; barrels returnable carriage paid.

Lead Acetate.—White, 51s. to 52s. 6d. per cwt. Manchester: £51 to £54 per ton.

Lead Nitrate.—About £47 per ton d/d in casks.

Lead, Red.—English, 5/10 cwt., £44 10s. per ton; 10 cwt. to 1 ton, £44 5s.; 1/2 tons, £44; 2/5 tons, £43 10s.; 5/20 tons, £43; 20/100 tons, £42 10s.; over 100 tons, £42 per ton, less 2½%, carriage paid, non-setting red lead, 10s. per ton dearer in each case.

Lead, White.—Dry English, less than 5 tons, £57; 5/15 tons, £53; 15/25 tons, £52 10s.; 25/50 tons, £52; 50/200 tons, £51 10s. per ton; less 5%, carriage paid; Continental material, £1 per ton cheaper Ground in oil, English, 1/5 cwt., £68 10s.; 5/10 cwt., £67 10s.; 10 cwt. to 1 ton, £67; 1/2 tons, £65 10s.; 2/5 tons, £64 10s.; 5/10 tons, £62 10s.; 10/15 tons, £61 10s.; 15/25 tons, £60 10s.; 50/100 tons, £60 per ton, less 5% carriage paid.

Litharge.—1 to 2 tons, £44 10s. per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 15s. to £22 15s. per ton.

Magnesium Chloride.—Solid (ex wharf), £16 to £18 per ton. Manchester: £14 to £16 per ton.

Magnesium Sulphate.—Commercial, £12 to £14 per ton, according to quality, ex works.

Mercury Products.—Controlled price for 1 cwt. quantities: Bichloride powder, 15s. 8d.; bichloride lump, 16s. 3d.; ammon. chloride powder, 17s. 10d., ammon, chloride lump, 17s. 8d.; mercurous chloride, 18s. 7d.; mercury oxide, red cryst, 20s. 9d.; red levig., 20s. 3d.; red tech., 19s. 11d.; yellow levig., 20s. 2d.; yellow tech., 19s. 7d.; sulphide, red, 17s. 9d.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 2s. 4d. per gal.; pyridinised 64° O.P. 100 gals., 2s. 5d. per gal.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—£60 to £65 per ton for ton lots, carriage paid, in 5-cwt. casks; smaller parcels would be dearer; deliveries slow.

Paraffin Wax.—Nominal.

Potash, Caustic.—Basic price for 50-100 ton lots. Solid, 88/92%, commercial grade, £53 7s. 6d. per ton, c.i.f. U.K. port, duty paid. Broken, £5 extra; flake, £7 10s. extra; powder, £10 extra per ton. Ex store, £3 10s. supplement. Liquid, d/d, £34 in lots of 1 ton.

Potassium Bichromate. — Crystals and granular, 7⅞d. per lb.; ground, 8⅝d. per lb., for not less than 6 cwt.; 1-cwt. lots, ½d. per lb. extra.

Potassium Carbonate.—Basic prices for 50 to 100 ton lots; calcined, 98/100%, £52 10s. per ton, c.i.f. U.K. port. Ex warehouse, £55 5s. per ton.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Iodide.—B.P., 8s. 8d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 55s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 10d. per lb. for 1 cwt. lots; for 3 cwt. and upwards, 1s. 9½d. per lb.; technical, £7 18s. 6d. to £8 10s. 6d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, 5 cwt. to 7 cwt., casks, 1s. 6d. per lb., d/d; supplies scarce.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

Soda, Caustic. — Solid 76/77%; spot, £16 7s. 6d. per ton d/d station.

Sodium Acetate.—£41 per ton, ex wharf.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 6¼d. per lb.; anhydrous, 6¼d. per lb., net, d/d U.K.

Sodium Bisulphite Powder.—60/62%, £19 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£21 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£36 to £45 per ton, d/d, according to quantity.

Sodium Hyposulphite.—Pea crystals, £20 per ton for 2-ton lots; commercial, £15 per ton; photographic, £22 per ton.

Sodium Iodide.—B.P., for not less than 28 lb., 9s. 11d. per lb., for not less than 7 lb., 13s. 1d. per lb.

Sodium Metasilicate.—£16 per ton, d/d U.K. in 1-ton lots.

Sodium Nitrite.—£20 to £23 per ton for ton lots.

Sodium Percarbonate.—21½% available oxygen, £7 per cwt.

Sodium Phosphate.—Di-sodium, £20 to £25 per ton d/d for ton lots. Tri-sodium, £26 to £30 per ton d/d for ton lots.

Sodium Prussiate.—8½d. to 9½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Sulphate (Glauber Salts).—£4 10s ton d/d.

Sodium Sulphate (Salt Cake).—Unground. Spot £4 11s. per ton d/d station in bulk. MANCHESTER: £4 15s. per ton d/d station.

Sodium Sulphide. — Solid, 60/62%, spot, £17 15s. per ton, d/d, in drums; crystals, 30/32%, £12 7s. 6d. per ton, d/d, in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, spot. £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.

Sulphur.—Per ton, for quantities of not less than 4 tons; ground, but not sieved, £15 10s.; ground and sieved, £17 15s. Controlled prices.

Sulphuric Acid.—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic-free, £4 11s. per ton; 140° Tw., arsenious, £4 3s. 6d. per ton. Quotations naked at sellers' works.

Tartaric Acid.—4s. 4d. per lb., less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 4s. 4d. per lb.

Tin Oxide.—Snow white, 305s.-315s. per cwt.

Zinc Oxide.—Maximum prices: White seal. £30 17s. 6d. per ton; red seal, £28 7s. 6d. d/d; green seal, £29 17s. 6d. d/d.

Zinc Sulphate.—Tech., £20-£21 per ton, carriage paid, casks free.

Rubber Chemicals

Antimony Sulphide.—Golden, 1s. 2d. to 2s. 1½d. per lb. Crimson, 2s. 2d. to 2s. 6d. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Best white bleached, £8 3s. 6d. per ton.

Cadmium Sulphide.—6s. to 6s. 6d. per lb.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Bisulphide.—£34 per ton, according to quality, in free returnable drums.

Carbon Tetrachloride.—£46 to £49 per ton.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes. White, 6 3/16d. to 10¼d. per lb.; dark, 6 3/16d. to 6 15/16d. per lb.

Lithopone.—30%, £25 per ton; 60%, £31 to £32 per ton. Imported material would be dearer.

Mineral Black.—£7 10s. to £10 per ton

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£49 per ton.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.
Plus 5% War Charge.

Nitrogen Fertilisers

Ammonium Phosphate Fertilisers.—Type B, See Concentrated Fertilisers.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, August, £9 10s.; increased charge of 1s. 6d. per month up to March, 1943.

Calcium Cyanamide.—Nominal; supplies very scanty.

Concentrated Fertilisers.—Per ton in 6-ton lots d/d farmer's nearest station, in August: I.C.I. Type, "Special III," £14 9s. 6d.; Type "B," £14 1s. 3d.; Type "C," £17 19s. Increased charge of 1s. 6d. per month up to March, 1943.

"Nitro Chalk."—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean super-refined for 6-ton lots d/d nearest station, £15 5s. per ton; granulated, over 98%, £14 10s. per ton. Surcharges for smaller quantities unless collected at warehouse or depots.

Coal Tar Products

Benzol.—Crude, 60's, 1s. 11d.; pure, 2s. 6d., per gal., ex works.

Carbolic Acid.—Crystals, 9½d. to 11½d. per lb. Crude, 60's, 4s. 3d. to 4s. 6d., according to specification. MANCHESTER: Crystals, 9¾d. to 11½d. per lb., d/d; crude, 4s. to 4s. 6d., naked, at works.

Creosote.—Home trade, 6½d. per gal., f.o.r., maker's works; exports, 6d. to 6½d. per gal., according to grade. MANCHESTER: 6½d. to 9d. per gal.

Cresylic Acid.—Pale, 97%, 3s. 6d. per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 6d. MANCHESTER: Pale, 99/100%, 4s. 6d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 8d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 2d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Naphthalene.—Crude, in 4-ton lots, in sellers' bags, £5 9s. to £8 9s. per ton, according to m.p.; hot-pressed, £10 5s. per ton; purified crystals, £19 to £35 per ton. Controlled priees.

Pitch.—Medium, soft, 45s. to 55s. per ton. f.o.b. MANCHESTER: 46s. per ton, at works.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 13s. to 14s. MANCHESTER: 14s. to 18s. 6d. per gal.

Toluol.—Pure, 2s. 5d. nominal; 90's, 1s. 10d. per gal. MANCHESTER: Pure, 2s. 5d. per gal. naked

Xylol.—For 1000-gal. lots, 3s. 1½d. to 3s. 4d. per gal., according to grade, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Wood Distillation Products

Calcium Acetate.—Brown, £21 per ton; grey, £24. MANCHESTER: Grey, £24 to £25 per ton.

Methyl Acetone.—40/50%, £56 per ton.

Wood Creosote.—Unrefined, about 2s. per gal., according to boiling range.

Wood Naphtha, Miscible.—4s. 6d. to 5s. 6d. per gal.; solvent, 5s. 6d. per gal.

Wood Tar.—£5 per ton.

Intermediates and Dyes (Prices Nominal)

***m*-Cresol** 98/100%.—Nominal.

***o*-Cresol** 30/31° C.—Nominal.

***p*-Cresol** 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb: 66/68° C., 1s.

***p*-Nitraniline.**—2s. 5d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.

Nitronaphthalene.—1s. 2d. per lb.; P.G.. 1s. 0½d. per lb.

***o*-Toluidine.**—1s. per lb., in 8/10 cwt. drums. drums extra.

***p* Toluidine.**—2s. 2d. per lb., in casks.

***m*-Xylidine Acetate.**—4s. 5d. per lb.. 100%.

Latest Oil Prices

LONDON. — March 10. — For the period ending March 27, per ton, net, naked, exmill, works or refinery, and subject to additional charges according to package and location of supplies: LINSEED OIL, crude. £46 10s. RAPESEED OIL, crude, £54. COTTONSEED OIL, crude, £39 12s. 6d.; washed, £42 15s.; refined edible, £48; refined, deodorised, £49. COCONUT OIL, crude. £36 12s. 6d.; refined deodorised, £40. PALM KERNEL OIL, crude, £36; refined deodorised, £40; refined hardened deodorised, £44. PALM OIL, refined deodorised, £46; refined hardened deodorised, £49. GROUNDNUT OIL, crude, £44; neutralised and bleached, £48; refined hardened deodorised, £53 to £54. WHALE OIL, crude hardened, 42 deg., £39; refined hardened, 42 deg., £42. ACID OILS—Groundnut, £27 10s.; soya, £25 10s.; coconut and palm-kernel, £31. ROSIN, 26s. 6d to 33s. per cwt., ex wharf, according to grade. TURPENTINE, American, 87s. per cwt. in drums or barrels, as imported (controlled price).

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Forthcoming Events

The annual general meeting of the **Society of Chemical Industry,** Yorkshire section, will take place in the Hotel Metropole, Leeds, at 5.45 p.m., on **March 15.** It will be followed by three short papers.

Four lectures on the modern power station will be delivered before the **Royal Society of Arts** in the near future. The first, on " The Boiler House," by Mr. C. H. Sparks, will take place at 1.45 p.m., on **March 15,** while the second, on " Coal and Ash Handling Plant," by Mr. J. F. Roy Mitchell, will be at the same time on **March 22.**

Sir Henry Dale is to give a series of four lectures on chemistry in modern medicinal treatment before the **Royal Institution,** at 3 p.m., on Tuesdays. The first, on **March 16,** will be about " Pre-scientific Discoveries," and the second, on **March 23,** on " Imitating Nature."

At a meeting of the Road and Building Materials Group of the **Society of Chemical Industry,** to be held at 1 Grosvenor Place, S.W.1, at 5 p.m., on **March 17,** Mr. A. R. Collins will speak on " The Frost Resistance of Concrete."

Dr. Dorothy Jordan Lloyd, F.I.C., is to give a lecture on " Leather " before the **Institute of Chemistry,** at 30 Russell Square, London, W.C.1, at 2.30 p.m., on **March 19.**

The Food Group of the **Society of Chemical Industry** will meet jointly with the Liverpool section, at 6 p.m., on **March 19,** in the Adelphi Hotel, Liverpool, when Sir John Russell will speak on " Trends of Agriculture in Relation to Nutrition."

There will be a meeting of the **Society of Chemical Industry,** Edinburgh and East of Scotland section, at 7.30 p.m., on **March 19,** in the North British Station Hotel, Edinburgh. Dr. H. W. Webb will speak on " Earthenware."

There will be a meeting of the **Institute of Chemistry** and the **Society of Chemical Industry** jointly with the **Leeds University Chemical Society,** in the chemistry lecture theatre of Leeds University, on **March 23.** A discussion on " The Training of the Industrial Chemist " will be opened by Professor F. M. Rowe and a student at 6.15 p.m.

The annual meeting of the Yorkshire section of the **Textile Institute** will be held at the Midland Hotel, Bradford, at 6.30 p.m., on **March 25.**

The Plastics Group and the Birmingham and Midlands section of the **Society of Chemical Industry** will meet jointly on **March 26,** at 2.30 p.m., in the Birmingham Chamber of Commerce, when Mr. H. L. Cox and Dr. K. W. Pepper will speak on "Paper Base Plastics—Part II."

There will be a joint meeting of the **Chemical Engineering Group,** the **Institution of Chemical Engineers,** and the **Society of Chemical Industry,** Glasgow section, at 7.15 p.m., on **March 26,** in the Societies Room, Royal Technical College, Glasgow, when a paper on " Multiple-Effect Evaporation in the Sugar Industry " will be presented by Mr. D. M. Semple.

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Forthcoming Events

The annual general meeting of the **Society of Chemical Industry,** Yorkshire section, will take place in the Hotel Metropole, Leeds, at 5.45 p.m., on **March 15.** It will be followed by three short papers.

Four lectures on the modern power station will be delivered before the **Royal Society of Arts** in the near future. The first, on "The Boiler House," by Mr. C. H. Sparks, will take place at 1.45 p.m., on **March 15,** while the second, on "Coal and Ash Handling Plant," by Mr. J. F. Roy Mitchell, will be at the same time on **March 22.**

Sir Henry Dale is to give a series of four lectures on chemistry in modern medicinal treatment before the **Royal Institution, at** 3 p.m., on Tuesdays. The first, on **March 16,** will be about "Pre-scientific Discoveries," and the second, on **March 23,** on "Imitating Nature."

At a meeting of the Road and Building Materials Group of the **Society of Chemical Industry,** to be held at 1 Grosvenor Place, S.W.1, at 5 p.m., on **March 17,** Mr. A. R. Collins will speak on "The Frost Resistance of Concrete."

Dr. Dorothy Jordan Lloyd, F.I.C., is to give a lecture on "Leather" before the **Institute of Chemistry,** at 30 Russell Square, London, W.C.1, at 2.30 p.m., on **March 19.**

The Food Group of the **Society of Chemical Industry** will meet jointly with the Liverpool section, at 6 p.m., on **March 19,** in the Adelphi Hotel, Liverpool, when Sir John Russell will speak on "Trends of Agriculture in Relation to Nutrition."

There will be a meeting of the **Society of Chemical Industry,** Edinburgh and East of Scotland section, at 7.30 p.m., on **March 19,** in the North British Station Hotel, Edinburgh. Dr. H. W. Webb will speak on "Earthenware."

There will be a meeting of the **Institute of Chemistry** and the **Society of Chemical Industry** jointly with the **Leeds University Chemical Society,** in the chemistry lecture theatre of Leeds University, on **March 23.** A discussion on "The Training of the Industrial Chemist" will be opened by Professor F. M. Rowe and a student at 6.15 p.m.

The annual meeting of the Yorkshire section of the **Textile Institute** will be held at the Midland Hotel, Bradford, at 6.30 p.m., on **March 25.**

The Plastics Group and the Birmingham and Midlands section of the **Society of Chemical Industry** will meet jointly on **March 26,** at 2.30 p.m., in the Birmingham Chamber of Commerce, when Mr. H. L. Cox and Dr. K. W. Pepper will speak on "Paper Base Plastics—Part II."

There will be a joint meeting of the **Chemical Engineering Group,** the **Institution of Chemical Engineers,** and the **Society of Chemical Industry,** Glasgow section, at 7.15 p.m., on **March 26,** in the Societies Room, Royal Technical College, Glasgow, when a paper on "Multiple-Effect Evaporation in the Sugar Industry" will be presented by Mr. D. M. Semple.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

DURASPRAY, LTD., London, W.C., metal preservative manufacturers. (M., 13/3/43.) February 17, £1000 debentures; general charge. *Nil. January 13, 1941.

HIGH SPEED STEEL ALLOYS, LTD., Widnes. (M., 13/3/43.) February 16, by order on terms. Trust deed dated November 2, 1942 (supplemental to Trust Deed dated June 12, 1922) extending date of payment of "B" debenture stock now outstanding. *£99,524. June 25, 1942.

LENSSENS, LTD., London, E.C., welders, etc. (M., 13/3/43.) February 24, £1300 debenture, to Metal Sprayers, Ltd.; general charge.

STEEL AND ALLOY PRODUCTIONS, LTD., London, S.W. (M., 13/3/43.) February 22, £300 debenture, to J. V. Phillips, London; general charge. *Nil. October 28, 1942.

Satisfaction

A. T. MORSE, SONS AND CO., LTD., London, E., paint manufacturers. (M.S., 13/3/43.) Satisfaction February 19, £5000, registered July 19, 1941.

Company News

Thos. W. Ward, Ltd., announce an interim dividend of 3¾ per cent. (same).

English China Clays, Ltd., announce a profit for 1942 of £49,729 (£35,173), and a dividend, as already stated, of 1 per cent. (nil).

British Xylonite, Ltd., announce a dividend of 7½ per cent., making 10 per cent. for the year (same.)

Courtaulds, Ltd., announce a final dividend on ordinary stock of 5 per cent., making 7½ per cent. (same) for 1942. The profit was £1,262,130 (£1,351,048).

John Oakey and Sons, Ltd., announce a final dividend on the ordinary shares of 10 per cent., making 12½ per cent. (10 per cent.) for 1942. The profit was £49,933 (£35,303).

Universal Asbestos Manufacturing Co., Ltd., announce a dividend on the ordinary shares for the year to September 27, 1942, of 20 per cent. (same) and a profit of £114,304 (£147,883).

Peter Brotherhood, Ltd., announce an interim dividend of 8 per cent. (same).

Anchor Chemical Co., Ltd., announce a final ordinary dividend of 17½ per cent. (15 per cent.), making 27½ per cent. (25 per cent.) for the year, and a net profit, to November 30, of £26,817 (£23,698).

The International Paint and Compositions Co., Ltd., announce an ordinary final dividend of 16 per cent., payable on March 31, making 20 per cent. for the year (same). The profit for 1942 was £243,336 (£214,181).

Dorman, Long and Co., Ltd., announce a dividend on the ordinary shares of 8 per cent. (7 per cent.) for the year ended September 30 last. The profit was £805,830 (£509,208).

Rubery Owen Messier, Ltd., announce that a new company styled **Rubery Owen (Warrington), Ltd.,** has been incorporated for the purpose of acquiring the assets and goodwill of that part of their business hitherto known as the general engineering division. The present company will operate the remaining portion of the business, hitherto known as the aircraft division, but in order to avoid confusion it is intended to change the name of the present company.

New Companies Registered

Gel-An, Ltd. (22,304).—Registered in Edinburgh as a private company. Capital: £300 in 300 shares of £1 each. Manufacturers, importers and brokers for general building trade chemicals, etc. Subscribers: R. L. Renfrew; G. P. Ritchie. Registered office: 65 Bath Street, Glasgow.

Glysan Products, Ltd. (378,939).—Private company. Capital £1000 in 1000 shares of £1 each. Manufacturing chemists, drysalters and manufacturers of chemical and food products, etc. Subscribers: Winifred Anderson, W. Symons. Registered office: Ling House, Dominion Street, Moorgate, E.C.2.

Romos Laboratories, Ltd. (378,975).—Private company. Capital: £100 in 100 shares of £1 each. Manufacturers of and dealers in emulsifying agents, to carry on research work, etc. First directors: D. Curwan and R. Wordsworth. Solicitors: Wordsworth and Co., 39 Lombard Street, E.C.3.

Chemical and Allied Stocks and Shares

INACTIVE and quiet conditions have ruled in the stock and share markets, and movements in industrial securities were small, and in most instances did not exceed more than a few pence. In many cases securities are so firmly held that they are in small supply in the market, and, consequently, prices tend to respond readily to

any small improvement in demand. Among shares of chemical and kindred companies, Imperial Chemical continued to attract increased attention, pending the dividend statement, and were again higher on balance, being 38s. 10½d., compared with 38s. 6d. a week ago. I.C.I. 7 per cent. preference units were 35s. 6d. B. Laporte remained very firmly held, and were again quoted at 78s. In other directions, General Refractories continued in request on hopes of an improved dividend, and these 10s. units have risen further to 15s. 10½d. Courtaulds were easier at 46s. 9d. having remained under the influence of the lower profits for the past year, but elsewhere, British Celanese were better on balance at 16s. 6d. A further sharp rise was shown in Barry & Staines, now 42s. 9d. Nairn & Greenwich improved to 63s. 9d., while Wall Paper Manufacturers deferred units were better at 35s. 9d.

Dorman Long remained active under the influence of the resumption of dividends, but subsequently eased to 24s. 6d. Stewarts & Lloyds had a firm appearance at 54s. 3d., and Tube Investments were 93s. 3d. Babcock & Wilcox remained at 50s. 3d. Birmid Industries did not maintain best prices recorded in the past few days, but at 83s. 6d. were higher on balance. Thomas De La Rue were again around 90s., and among shares of other companies connected with plastics, British Industrial Plastics 2s. ordinary were better with dealings up to 5s. 9d., Erinoid around 11s. 3d., and Catalin 3s. 9d. Lacrinoid Products 2s. shares were around 4s. 10½d., awaiting the financial results, due in a few weeks; it may be recalled that in respect of 1941 higher profits were shown, and the dividend was raised from 7 per cent. to 9 per cent. Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. This is another case where publication of the results can be expected shortly. Business up to 17s. 9d. was shown in British Thermostat 5s. ordinary shares, at 19s. 9d. in Burt Boulton, and up to 13s. 1½d. in Goodlass Wall 10s. ordinary. Borax Consolidated deferred were 34s.

British Tar Products 5s. shares transferred up to 10s. 3d., British Emulsifiers 2s. ordinary around 3s. 3d., while in other direction, British Drug Houses were again 22s. 6d. Ilford ordinary transferred around 45s. 6d. More attention was given to Greeff-Chemicals 5s. ordinary, which changed hands up to 7s. 3d., it being pointed out that a satisfactory yield is shown on the basis of the 10 per cent. payment made for 1941. British Aluminium were little changed at 49s. 3d. There are general expectations that the dividend for 1942 is likely to be maintained, the assumption being that the placing of a good proportion of profit so reserves will be contnued. Many companies connected with the chemical and allied industries have followed a very conservative dividend policy since 1940. The building up of reserves is to the ultimate benefit of shareholders, bearing in mind that companies with strong financial resources will be better able to meet the difficulties of the post-war period. Meanwhile, it is apparent that in many instances the tendency is for the strength of the balance-sheet to have as important a part in governing the market value of shares of individual companies as the question of the immediate dividend yield. British Oxygen have been firm at 77s. 3d., while elsewhere, Lever & Unilever improved from 34s. 6d. to 35s. Dunlop Rubber, however, at 34s. 6d. were unchanged on balance, but elsewhere Boots Drug were moderately higher at 40s. 6d. Among oil shares improvement was recorded in Anglo-Iranian.

BRITISH GUIANA BAUXITE

Three bills adjusting the taxation on bauxite have been passed by the British Guiana Legislative Council. One removes the exemption of the mining industries from E.P.T., but provides reasonable allowances for amortisation of capital expenditure incurred in expansion of output for war purposes. Allowances are limited to not more than 50 per cent. of excess profits in any chargeable accounts period. The second authorises the amounts allowed under the E.P.T regulations to be treated as a deduction from chargeable income, while the third bill removes the special export duty of 20 cents per ton, which was imposed on bauxite in 1940, in view of the introduction of E.P.T., and re-applies the general export duty of 1½ per cent. *ad valorem*.

CHARCOAL FROM GUM LEAVES

High-grade charcoal is claimed to have been made from the discarded leaves and twigs of eucalyptus trees by Dr. H. T. Meurer, an Australian inventor, according to the *Industrial Australian and Mining Standard*. It is further claimed that the charcoal contains only 1 per cent. of ash, and that the gas produced blends well with vaporised petrol. By the "Eucol" process, as it is called, 4 tons of waste material are said to produce 32-40 cwt. of charcoal, as against the 20 cwt. derived from four tons of valuable timber. The process entails mixing the waste wood, etc., with brown coal and superheated steam, and it is stated that the residue, after the oil and gas have been lifted, consists of a charcoal of high calorific value, from which fuel in briquetted form can be made for different types of furnace. By-products include branding-oil, sheep dips, disinfectants, waxes, and dyes. It is reported that plans for the erection of plant are being developed.

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